The FOUNDRY

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Delves Into Fundamentals of Foundry Practice

WITH this issue, THE FOUNDRY begins publication of a series of interesting articles on foundry practice which are written to benefit that vast body of readers seeking to learn more of the fundamentals which underlie the foundry industry. The first of the series, starting on page 94, discusses the part that sand plays in the production of castings, placing special emphasis on the composition of sands, physical characteristics of the various types of foundry sands, types of materials necessary for dry and green sand molds, and methods of testing. This subject is dealt with in sufficient length to provide a ground work for the discussion to follow on equipment, materials and methods employed in the manufacture of castings. As the series progresses, the author will complete the study of the elements of molding, typical jobs in green sand, examples of highly skilled work, the production of cores, and the methods of melting the metal. The series. which is entitled "Fundamentals of Foundry Practice," will appear in subsequent issues of THE FOUNDRY during the greater part of 1930. The author, Ivan Lamoureux, is well fitted to prepare such an extensive study of the important factors affecting foundry practice. For a number of years prior to the war he managed a large foundry and more recently has been engaged in the manufacture and sale of foundry equipment.

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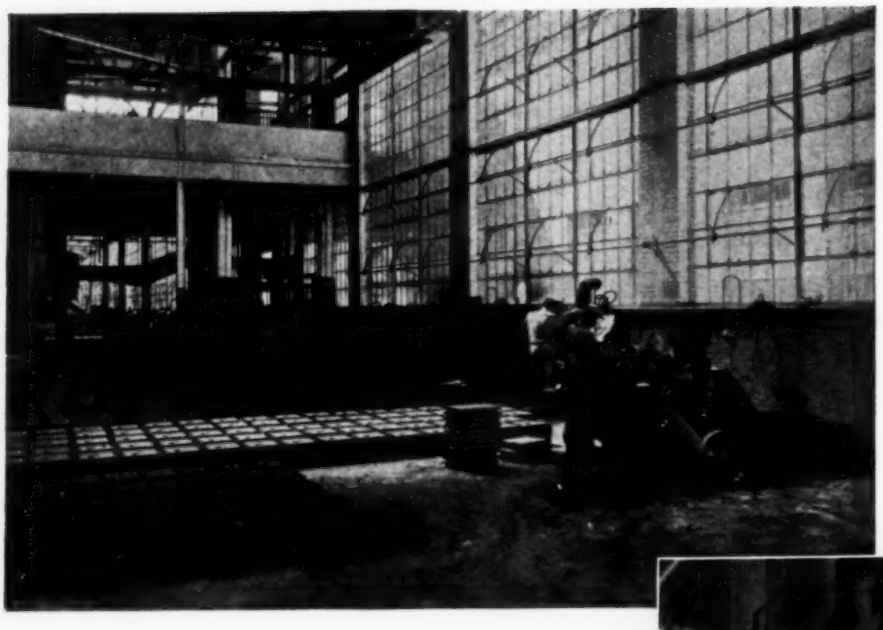
Makes

By

Pat Dwyer



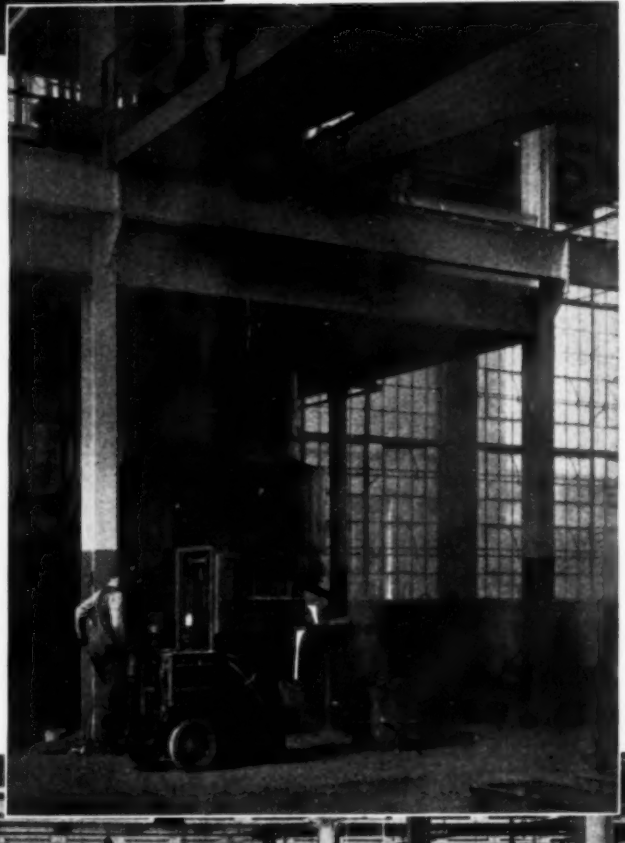


Fig. 1—(Top)—Typical Side Floor Near the Cupola. Fig. 2—(Center)—A Truck Handles Part of the Molten Iron. Fig. 3—(Below)—One of the Side Bays

AMONG all the wise saws, maxims and proverbs which adorn the English language, probably the most familiar is the one which touches on the absurdity of attempting to convert the tough, leathery ear of a female swine into a silk purse. The proverb does more than touch on the fringe of the subject. Quoting merely from memory this particular proverb runs: You can't make a silk purse out of a sow's ear.

There it is, a plain, blunt statement, rough and uncouth as a pig's nose. You can take it or leave it. That is just what men did for many years, took it or left it. Ninety-nine and perhaps a few extra hundreths per cent accepted the statement and accepted it as gospel. The infinitesimal minority doubted the statement, but since they knew no more of silk purses—or any other kind of purses—than they did of pig's ears, their interest was not aroused.

Undoubtedly, these doubters some day will come into their own. A silk purse from a sow's ear surely is no more remarkable than a silk purse or a pair of silk stockings from a hunk of cord wood and that is a feat that now is accomplished daily. Synthetic chemistry has been striding around the world in seven league boots since the alliterative sow's ear and silk purse slogan first was flung to the breeze. The foot—in silk or near silk—should be held discreetly on the soft pedal during discussions on what can and what can not be

Textile Machinery *Castings in a* New Foundry

Fig. 5—(Right)—Cupolas Are Charged by hand. Fig. 6—(Upper Right)—Grinding Wheels Are Protected by Elaborate Guards

done in the wide field of art and industry.

In the early nineties a few men in Europe invested a small amount of capital in a process for converting wood pulp into artificial silk. Of course it could not be done and the 99 per cent of the number who heard of the venture did not hesitate to tell them so. The proverb of the sow's ear was quoted freely and often, but these stubborn men persevered. Tremendous expansion of the rayon industry in recent years would seem to indicate that while a pig's ear may be suitable for proverbs and other light service, it lacks the reliability and other sterling characteristics which one naturally associates with a standard of comparison.

According to statistics 1,000,000 pounds of artificial silk were manufactured in the United States in 1912 and 1,600,000 pounds were imported. Each succeeding year saw a startling increase in these figures until in 1927—the latest available—the production and importation of rayon into the United States amounted to 80,594,000 pounds. The production for the entire world is given as 250,500,000 pounds for the same same year while the world production of real silk totaled only 93,348,000 pounds.

Fig. 4—(Left)—Ample Floor Space Is Provided. Fig. 7—(Above)—Tumbling Barrels Are Driven Individually

Fig. 8—Rail Castings Are Made Two in a Flask

At about the same time that Chardonet was conducting his first successful experiments toward the production of artificial silk, two young Germans after a few years residence in the United States formed a partnership in Reading, Pa., for the purpose of repairing and manufacturing braiding and knitting machinery. The number of silk stockings in those days is indicated by the fact that the term was employed—enviously—as a designation for those who possessed wealth in disgusting quantity.

Still in Control

The present Texile Machine Works, Berkshire Knitting Mills and the Narrow Fabric Co., comprising the Wyomissing Industries are owned and presided over by president Henry Janssen and secretary Ferdinand Thun, the same pair who established the modest partnership of Thun & Janssen in 1892. In 1896 the activities of the firm were transferred to a new plant erected near the Reading railroad in the borough of Wyomissing. Fundamental policy of the company has been to enlarge the manufacturing facilities at every favorable opportunity and to open kindred industrial activities whenever and wherever a chance offered. The latest unit to be added to the plant is a large foundry 345 x 820 feet in which all the iron, brass and aluminum castings required for its extensive line of machinery, are made.

Fig. 9—A Special Laundry Is Provided for Men's Clothing

Silk, near silk, cotton, wool and various combinations of all four are converted into stockings at the rate of 55,000 dozen pairs per week in the company's own plant. Machinery for making many other thousands, perhaps millions, in knitting plants in the United States and foreign countries eventually will tax even this large foundry to capacity.

Rapid expansion of the company's business in recent years outgrew the capacity of the original foundry erected in 1901. A tract of land on the north, or opposite side of the railroad from the remainder of the plant was selected as a site for a large, modern foundry. Members of the executive and operating staff made an extensive tour of the country and inspected buildings and operating conditions in many foundries. Out of the composite knowledge gained in this manner the present foundry was planned and erected. By moving personnel and equipment one department at a time, practically no production time was lost between abandonment of the old foundry and full time operation in the new one.

Fig. 10—Exhaust and Other Pipes Are Carried in Tunnels

The building 345 x 820 feet of brick, concrete, steel and glass construction is practically fireproof and designed to supply a maximum of light and ventilation. In addition to the continuous sash in the sides and ends of the building, 20 transverse monitors on the roof are provided with movable windows operated by push button control from stations near the floor. The floor is laid smoothly in cement with the exception of that part in the cleaning, shipping and storage department which is formed of wood blocks on a concrete foundation.

One of the outstanding characteristics of this foundry is the ample floor space provided. A wide gangway

extends from end to end of each bay and these are connected at several points by equally wide gangways which extend across the shop from side to side. This arrangement conforms to the safety first policy which prevails throughout the entire plant. Also it greatly facilitates the movement of many kinds of material on trucks either singly or coupled to trailers.

Part of this prodigality of floor space is due to the fact that the shop was planned not only for present requirements, but also for anticipated greater demand in the future. At present a considerable number of outside orders for castings are filled regularly. An efficient cost system enables the management to keep a close check on the cost of individual items. Quotations on outside work are based on the same system. Solicitation is limited to those classes of gray iron castings which conform to the same chemical and physical analyses as the regular run of work. That is a soft, fairly strong and easily machinable iron. Approximately half the gray iron castings are made for outside interests, while the proportion in the nonferrous section of the foundry is somewhat higher. Under present operating conditions the output is approximately 100 tons of gray iron and 4 tons of nonferrous castings per day.

With its spotless buildings, gorgeous flower beds, smooth lawns, winding drives and colony of fantail pigeons strutting imperiously, the group of buildings comprising the main plant constitutes one of the show places of the city. The new foundry was designed to harmonize with the general scheme. Order, cleanliness and neatness are observed as the three cardinal virtues. If a fourth is to be included it is comfort of the employes. Surroundings and conditions in a general way reflect the neatness, precision and high finish of the product.

Fig. 12—Rail Castings Are Poured Through a Long, Heavy Runner Supplemented by Four Risers

Shower baths and lockers on an elaborate scale are maintained in a long room above the foundry office and power station. A laundry is operated on the lower floor where the employes may have their clothing washed. Noon day lunch is served at less than cost in a cafeteria which seats 300.

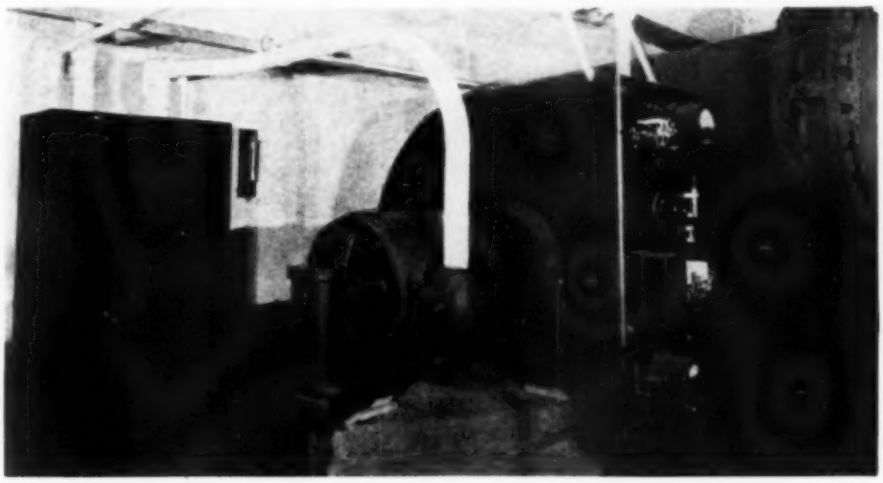


Fig. 11—The Blower Is Equipped with an Automatic Regulator

The power station, shining and immaculate, occupies a room in this group of auxilliary departments located at the southwest corner of the building. All the elaborate electrical equipment of the foundry is controlled from a long switchboard in this room. Compressed air for the molding machines, sandblast installation and pneumatic tools is supplied by two angle compound compressors made by the Sullivan Machinery Co., Chicago. Each one is driven by a 212-horsepower motor made by the General Electric Co., and has a capacity of 1100 cubic feet of air per minute. The interior of this room, 4 feet above the floor is painted white. The remainder of the walls, corresponding to a wainscot, is painted the color adopted by machine tool builders and known as battleship gray. The same color scheme is in evidence throughout the entire foundry. A crew of men finds constant employment wash-

Fig. 13—Wood Three-Part Flasks Contain the Molds For Castings Shown in Fig. 16 at the bottom of the following page

Fig. 14—Part of the Nonferrous Section of the Foundry

ing the windows, while a second crew keeps the floor and gangways in presentable condition.

The general layout of the interior and the relative position of the various departments are shown in Fig. 19. The foundry is served by two spur tracks from the main line of the Reading railroad, one on either side of the building. The spur on the north side carries the raw material into a stockyard that is roofed completely and in which a mezzanine floor serves as a roof to a long row of concrete bins. A 3-ton crane made by the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y., unloads the pig iron, and coke from the railroad cars and piles them on the mezzanine floor. Return scrap from the foundry is taken up on an elevator to the charging floor. Sand is dumped through trap doors in the floor into the concrete bins below. The track on the south side of the foundry is laid close to a long concrete loading dock from which the castings are shipped, either by rail or by auto truck. Castings also are loaded on trucks which back in under canopies that protect two large doorways in the west end of the building.

Fig. 15—Cores Are Loaded on Racks and Dried in a Battery of Four Electric Ovens

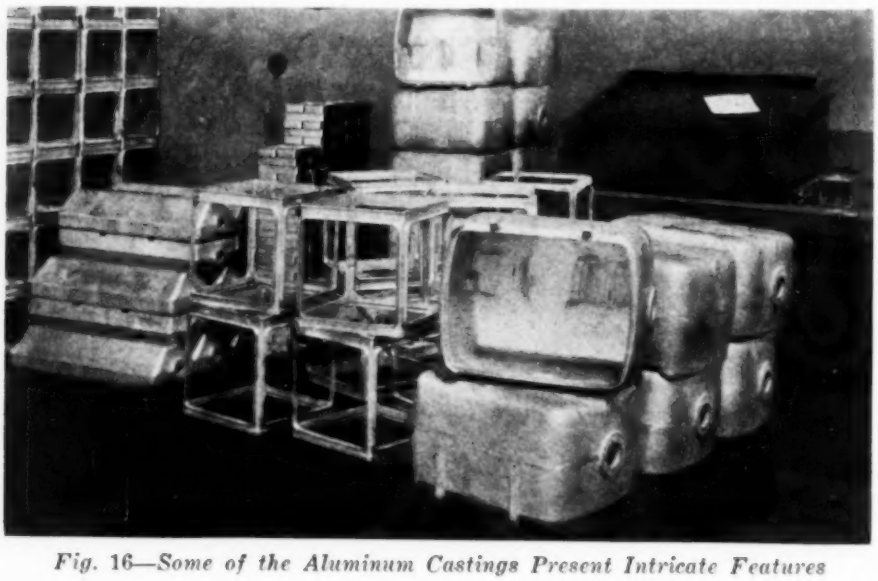


Fig. 16—Some of the Aluminum Castings Present Intricate Features

Patterns are stored on indexed racks in a basement which extends under the east end of the building for a distance of 300 feet east and west and the full width of the foundry proper, 240 feet, north and south. The dimension 345 feet given on a preceding page includes both foundry and stock yard. They lie adjacent to each other and are only separated by a narrow roadway. The mezzanine floor in the stock building and the charging floors of the cupolas are on the same level and are connected through covered passages. Pipes for various purposes are carried in tunnels under the foundry floor.

Charges Cupola by Hand

Charges of 2000 pounds of pig iron and 800 pounds of scrap are made up on four-wheel trucks and are pushed or pulled by hand to a position in front of the cupola where the material is charged by hand. The four cupolas, 72 inches in diameter inside, supplied by the Whiting Corp., Harvey, Ill., are arranged in pairs approximately 300 feet apart and the same distance from the ends of the building. Blast is supplied by the centrifugal blower made by the General Electric Co., which automatically regulates the volume of air according to the weight. The average blast pressure on these cupolas is 18 ounces.

On account of the size of the castings, the gates, sprue and defective castings furnish all the scrap required in the charges. No outside scrap is used. Even on the large castings the special character of the gates and runners absorbs more than the usual quantity of metal. This may be noted in a striking manner in Figs. 8 and 12 showing open and closed molds for castings known as rails. Fig. 8 shows the long continuous runner in the cope which supplies the small gates entering the two molds one on either side. Fig. 12 shows the opening of the four large risers extending upward from this long runner and which act as dirt catchers and feeders. The metal is poured in at one end. Combined weight of gates, runner and risers in one of these flasks is equal to the weight of one of the castings, or, one third of the metal poured.

The section of the foundry floor shown in Figs. 4 and 12, is utilized

for the production of many types of castings. Pattern and flask equipment is changed to meet production schedules but all the sand is packed into the flasks by two sand slinging machines. These machines are of the tractor type and move along a track under their own power. Starting at either end of a long sand pile, they utilize the sand and move toward the center. In the particular instance shown, each machine with a crew of three men is responsible for the production of 25 molds, each containing two castings.

Crane service on this floor is supplied by a 5-ton crane made by the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y. With the exception of two cranes in the tumbling mill room, all the cranes in this new foundry were supplied by the same company and include four 5-ton cranes in the bay shown in Fig. 12, one each of similar capacity in each of the other three bays and one 3-ton crane in the stock building. This extremely generous crane equipment and service is in line with the general policy of the company.

Special Flasks

To insure straight, clean and solid castings, the rails are molded and gated in the manner shown. The flasks are made up of steel channel sides and cast iron ends with trunnions to facilitate rolling cope and drag while suspended from a beam and a pair of slings. Bottom boards are constructed of 1½-inch plank mounted on seven 2 x 4-inch battens spaced on 2-foot centers. The castings are allowed to remain in the flasks from the time they are poured in the afternoon until after midnight. By that time all danger of warping has been eliminated and they are shaken out. The sand then is prepared for the ensuing day's work. The empty flasks and the bottom boards are stacked at convenient points to be picked up later and utilized as the molding machine moves along its appointed track. If the day's schedule calls for another job, the rail flasks are stacked out of the way, and the required flasks are set in their place.

The sand slinging machines on this particular floor, prepare the sand, cut it over, lift it from the heap, riddle it and throw it into the flask. The remainder of the sand in the foundry is cut over and arranged in suitable piles at the many molding stations by a group of three sand cutting machines made by the American Foundry Equipment Co., Mishawaka, Ind.

Each cupola is equipped with an auxiliary tilting spout set slightly below and at right angles to the regular spout. This tilting spout directs the flowing stream alternately into a ladle at the right and one at the left. Thus while one is filling, the second may be removed and replaced by one that is empty.

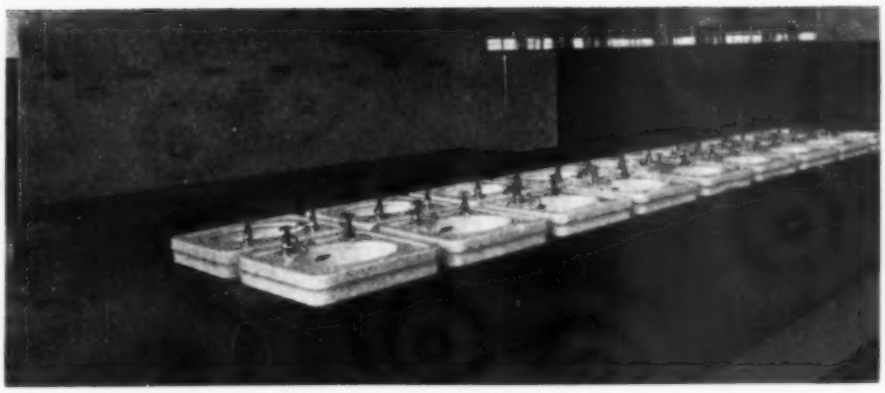


Fig. 17—One of the Wash Stands with Shower Baths in the Background

Ladles of 2-tons capacity are handled directly by the crane in a manner familiar throughout the foundry industry. Smaller ladles holding approximately 2000 pounds are handled in an original manner on a lift truck made by the Yale & Towne Mfg. Co., Stamford, Conn. A steel member projecting from the front of the truck converts it into a small jib crane from which the ladle is suspended.

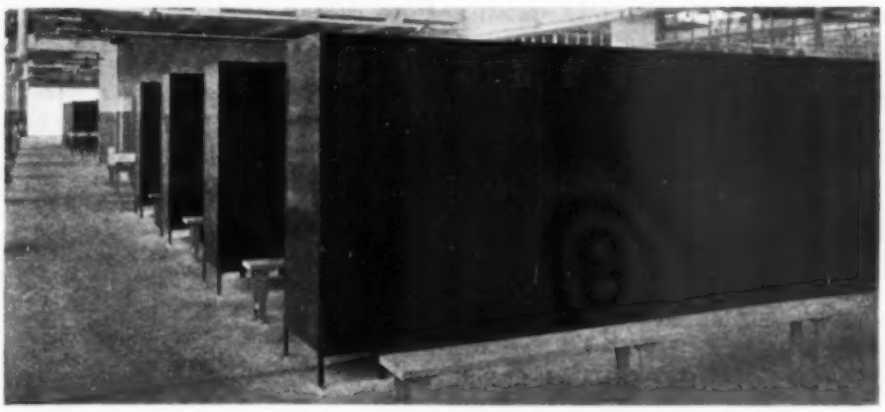


Fig. 18—Safe and Sanitary Lockers Are Provided for the Employes

In effect the ensemble corresponds to one of the wrecking trucks maintained by service stations for the benefit of unfortunate motorists. With this device the ladle is carried to any designated place on any of the

(*Concluded on Page* 103)

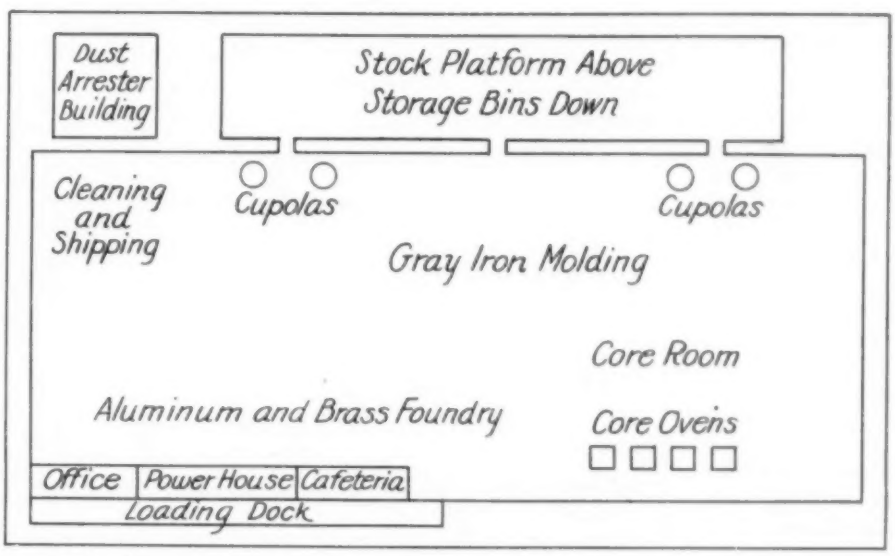


Fig. 19—General Layout of the Foundry Showing Location of Departments

Fundamentals of
FOUNDRY PRACTICE

Molding Sand Offers Important Subject for Consideration—Properties of Sands and Mixing Equipment Are Discussed

By Ivan Lamoureux

[Interpreted in the Light of American Practice by Pat Dwyer]

Part I

MOLDING sands to a great extent are obtained by selecting sands of a sedimentary origin, or from sands obtained from the disintegration or breaking up of rocks.

Disintegration is caused by chemical, physical or mechanical actions, corrosion, erosion and frost. Sediments are natural deposits, slowly formed on the surface of the earth, by the action of the oceans, water-courses, glaciers and winds. The majority of molding sand deposits trace their origin back to remote periods. Glaciers, winds and water, in shifting the sands about, mix them, roll the particles over one another, so that gradually the grains lose their roughness, and become more and more rounded.

Gives Components of Sand

Minerals entering into the composition of sands are numerous. The essential elements of a good molding sand and silica and alumina in the form of clay; while among the secondary elements, the principal ones are lime, magnesia and the metallic oxides.

Silica is a preeminently fine refractory material, it resists heat perfectly, does not fuse except at high temperatures, and forms the principal constituent of molding sands. However it does not by itself possess any bond or cohesiveness, no faculty of being molded, so that if employed alone, a sand with a high silica content is not suitable for molding purposes. Alumina in molding sand constitutes the binding element, which causes the grains of silica to adhere to each other, and which thus makes it suitable for obtaining impressions. Silica alone would result in a dry sand which it would be impossible to ram into any shape for molding purposes.

A large proportion of alumina increases the cohesiveness and plasticity of the sand, but causes cracks to form upon drying out in the mold. Furthermore, an excess of alumina prevents the gas from escaping and aids in the formation of blowholes in the castings. Sands therefore should be used which combine silica and alumina in suitable proportions. Molding sands usually contain 85 to 95 per cent silica and from 2.00 to 10.00 per cent alumina. The remander is composed of the secondary elements, at times neutral, but often detrimental to use of the sand for molding purposes.

Sand Composition

Magnesia softens the sand, but the amount should not exceed 1.50 per cent, otherwise its presence will prove detrimental. When combined with the silica it forms silicates of magnesia which are fusible at comparatively low temperatures.

Lime is found occasionally in molding, sands where its presence is tolerated up to about 1.50 per cent. Above 1.50 per cent, lime will cause vitrification of the walls of the mold which are in contact with the melted iron. Therefore, it is a detrimental element. To discover the presence of lime in the sand, recourse may be had to either of the following tests,

1. Place a small quantity of sand

Sand Characteristics

SINCE sand plays such an important part in the production of castings, the author devotes the opening chapters of the present series to a description of its origin and the special characteristics required of a sand in which molds are to be made. Some sands are specially adapted to the production of light castings, while others are more suitable for use in establishments where heavy castings are turned out. The relative proportion of bonding material, moisture, and silica, constitute the determining factors. The size and shape of the individual grains exert an important influence in the choice of a sand for any definite line of castings. A fundamental knowledge of sand characteristics, and how these characteristics must be combined for satisfactory manipulation, is essential to the foundryman. The author quite properly dwells upon these features to a reasonable extent so that the student may be thoroughly grounded before taking up the study of equipment material and methods involved in the production of castings.

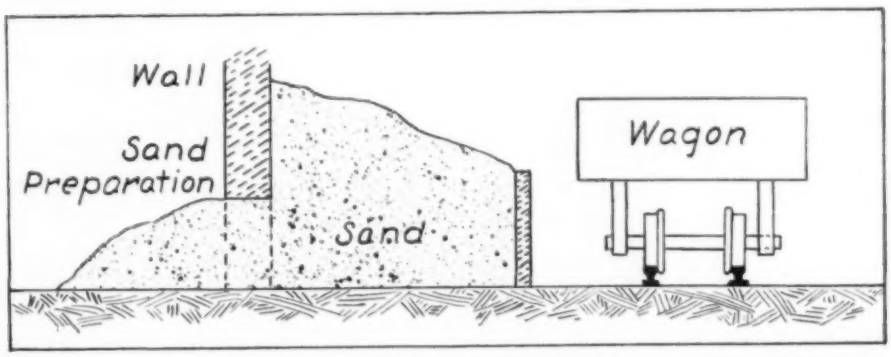


FIG. 1—IN THIS TYPICAL SAND STORAGE SYSTEM THE SAND PASSES FROM THE INCOMING CARS TO A CONCRETE BIN AND THENCE TO THE MIXERS

in a bath of water and hydrochloric acid. If ebullition takes place in the liquid and gas bubbles are given off, it is indication that the sand contains lime.

2. Place a small quantity of the sand in a small crucible and then bring it up to a high temperature. If the sand vitrifies, it is an indication that it contains lime, and should be rejected by the foundryman.

Oxide of iron if present in large amount imparts a pronounced brown color to the sand, the coloration increasing with the oxide content. In sands intended for molding large castings, a percentage of iron oxide varying from 1.00 to 1.50 per cent is permissible, whereas in sands intended for molding small castings, which cool rather quickly, amount up to 3.00 per cent of iron oxide may be tolerated without inconvenience. Therefore it is preferable to select sands of a light color for pouring castings of large size. Pure silica is a refractory material, but, if combined with certain proportions of lime, magnesia and metallic oxides, it forms silicates which are fusible at comparatively low temperatures.

Physical Characteristics

For that reason silicates almost always are detrimental. Hence the less foreign substances the sand contains, outside of the silica and alumina, the purer it is.

For purpose of comparison it may be interesting to compare the typical sand analyses of European molding sands given in Table I with a somewhat similar compilation made of American molding sands at one time made by E. W. Smith shown in Table II and presented in THE FOUNDRY, April 1, 1922. The reader will note in particular that the chemical analyses alone do not convey sufficient information. Several sands of quite widely varying chemical analyses, are found perfectly satisfactory for the production of identical castings in different sections of the country. The chemical analysis constitutes only one of several tests which the foundryman must apply to secure dependable information.

Table I

Chemical Analyses of Molding Sands

Class	Silica Per cent	Alumina Per cent	Oxide of Iron Per cent	Lime Per cent	Magnesia Per cent	Loss on Ignition Per cent
Fat.....	85 to 89	6 to 10	2 to 4	0.20 to 0.50	0.12 to 0.30	0.35 to 2.50
Semifat.....	87 to 91	3.5 to 7	1 to 3	0.10 to 0.40	0.12	0.35 to 2.20
Weak.....	90 to 95	2 to 4.5	1 to 2.5	0.10 to 0.30	0.10	0.35 to 1.70
White.....	92 to 97	0.50 to 1.5	0.5 to 1	0.10 to 0.50	0.10 to 0.20	0.20 to 0.90

A grain of sand, which should not be confused with a lump of sand, is a particle perfectly free and independent of any other bodies surrounding it and which cannot be divided without destroying it. The average size of each of the particles of which a sand is composed, is what determines what we are accustomed to call the *grain* of the sand.

The larger the casting to be molded, the purer should be the sand used, and the coarser the grain. In molding small parts, a fine sand moderately fat (to have sufficient porosity) gives clean impressions and as smooth a surface as is possible to obtain. The sand used in molding small pieces does not have to be of such absolute purity as that used in molding of large castings, and that is because, the small castings cool rapidly after pouring and the heat consequently does not have time to exert its pernicious influence on the impurities in the sand. In general, the size and uniformity of the grains assure the maximum of porosity, and consequently permit the use of a fat sand, and therefore a plastic or cohesive sand.

The term *fat* as applied to molding sand is not used by American foundrymen. On this side of the Atlantic the word as an adjective has almost lost its original meaning and now simply is a synonym for large, gross, unwieldy. In recent years, principally through the efforts of the American Foundrymen's association, sand is referred to as high, low, or medium bonded. In the shop a molder squeezes a ball of sand in his hand and says it has a good, poor or no body depending on the feel. The word *body* in this instance meaning the degree of cohesivness.

Porosity is that property which substances have of presenting more or less small spaces, called pores, between the different particles and between their different molecules.

Uniform Grain Size

Molding sands should be porous, to allow the gas to escape from the mold during the pouring process and thus avoid a variety of serious accidents. The permeability of sand is that property which permits steam and gases to pass through the mass.

There are fat sand and weak sand, coarse-grained and fine grained sands. Molding sands should be granular, that is when the sand is rolled between the fingers, the different particles should be felt plainly, and not leave the impression of fingering a powder. This is an indispensable requirement for the permeability of the sand.

Molding sands should be uniform. They should be composed of grains of

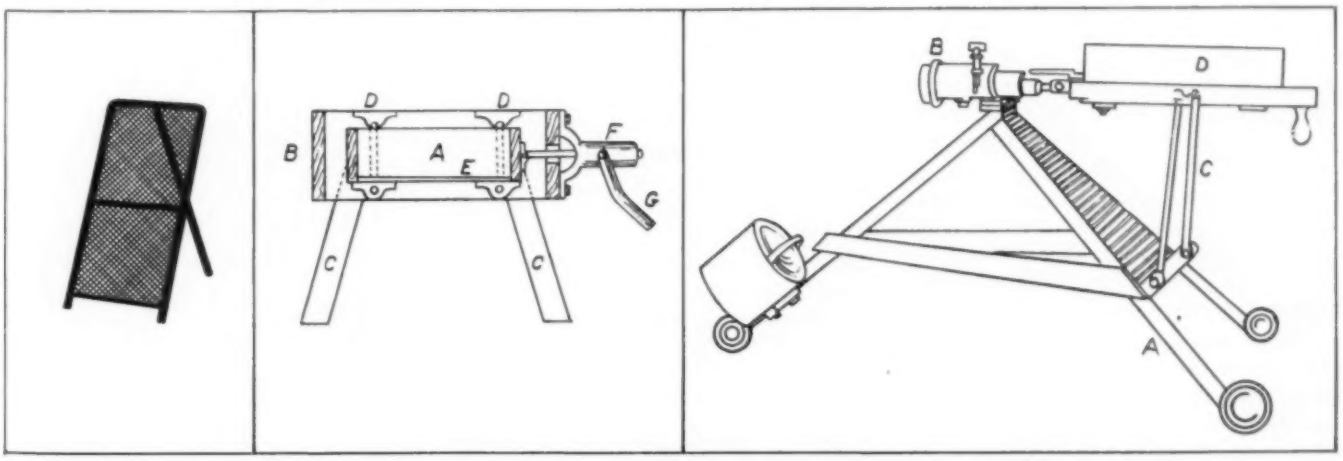


FIG. 2—AN ORDINARY COARSE MESH FLOOR SCREEN FOR MIXING SAND. FIG. 3—RECIPROCATING RIDDLE ACTUATED BY AIR MOTOR. FIG. 4—AN ORDINARY RIDDLE IS PLACED IN THE OSCILLATING MEMBER

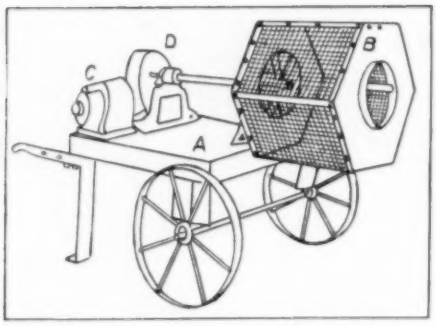


FIG. 5—THIS ELECTRICALLY DRIVEN REVOLVING RIDDLE MAY BE TAKEN FROM PLACE TO PLACE

as uniform a size as possible, and homogenous. That is why the foundryman before using them, prepares them in special apparatus to be described later.

A mold prepared with uniform fine grained sand free from dust, gives better results than a mold prepared with coarse-grained sand and containing a lot of dust and fine grains.

To mold large castings, it is preferable to use coarse-grained sand, as it contains less dust than fine-grained sand.

Dry Sand Molds

If part of a mold is made of coarse-grained sand, and then another part made of fine-grained sand, is attached, the latter will come off at the time of pouring. The two different kinds of sand will not stick to each other.

Plasticity is that property which certain substances (clay, wax, etc.) have of being able to assume various shapes through modeling or molding. Molding sands should have a certain degree of plasticity which is imparted to them by the presence of alumina.

Green sand (composed of new sand and old foundry sand) should have sufficient plasticity to enable it to take an impression in the cope of the mold without any fear of the sand dropping out.

However, it should be noted that if the sand is too fat, the mold will produce rough castings. As a general rule, the heavier, thicker and larger the casting, the fatter the sand should be and it should contain a large proportion of powdered coal.

Pieces cast in open molds should have the molds made of thin sand, which will allow a quick escape of the gases. However, if too thin, the sand will cause scabs on the castings.

Stove sand or dry sand should be fat but not to excess. An excess of alumina will cause numerous and large cracks at the time of drying the mold.

In loam-molding, the backing loam can be fairly hard or fairly rich. The facing sand which comes in contact with the melted iron must be rather thin, to avoid cracking in drying.

To preserve the quality of the molding sands, they should be kept under cover. A sand exposed to rain, wind, sun and frost loses its cohesiveness and absorbs a considerable amount of moisture which makes it unfit for molding purposes. Brickmakers take off the top layer of clay and pile it in large heaps before winter sets in and leave it thus exposed in all kinds of weather until spring. This clay which was hard to crush and mill, becomes brittle or crisp and can be milled easily.

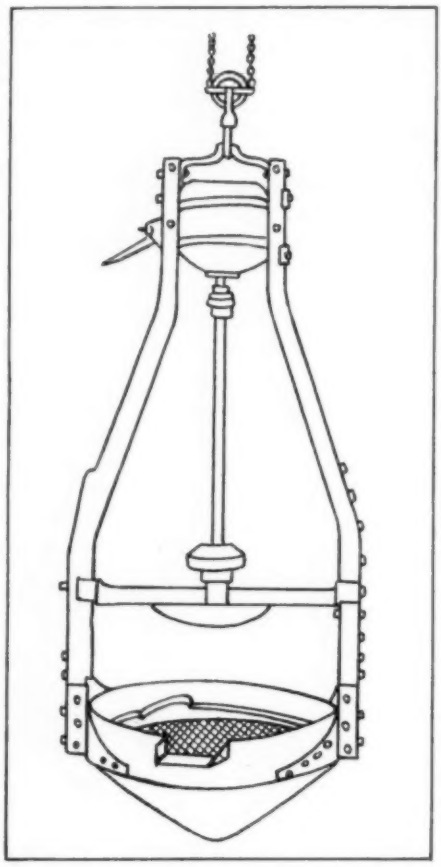


FIG. 6—SUSPENDED RIDDLE IN WHICH THE SAND IS SIFTED BY A GYRATORY MOTION

The elements react the same way on molding sand, if left exposed to the air, but they make it considerably thinner and diminish its plastic qualities.

Sand is stored in sheds, with the different grades of sand separated. Where the storage shed is attached directly to the foundry, the sand is unloaded into it direct from the cars. Whenever possible, the sand preparing department is separated from the storage bins by just a plain wall provided with openings at the bottom through which the sand can be drawn as required.

Floor sand is the sand covering the floor of a foundry and which is placed in heaps at each molding stand. After the molds are poured, the small castings are broken from the gates and piled with the risers and scrap at the end of the floor or in the gangway. The sand is sprinkled and is ready the following morning to be treated when it is gathered in a heap and passed through a 15 to 25 millimeter (3/5 to 1-inch) mesh screen.

In America, in some cases the sand is cut with a shovel. The sand is gathered up from both sides of the molding stand and piled in a long heap, then it is turned over scoop by scoop and moved a little further toward the back of the floor to form another heap as before. By this operation the sand becomes thoroughly mixed. Large plants make use of equipment which performs all of these operations mechanically at each of the molding stands. In many modern, well-equipped foundries, instead of passing the sand by hand through a stationary screen, it is screened by special equipment driven either by compressed air or electrically.

Mix the Sand

Fig. 3 shows a wooden box screen driven by compressed air. This outfit consists of a rectangular screen *T*, 17¾ x 30 inches, which moves in a wooden box *B*, mounted on four wooden supports *P*. The screen oscillates on the cranks *A* pivoted to the bearings *C*. The metal screen is easily removable and can be replaced by screens of different size mesh. The hose *V*, about 13 feet can be attached to any of the compressed air outlets. Usually all the columns supporting the roof-trusses of the foundry are provided with compressed air outlets. The screen generally is oscillated by small compressed air motor *M*, although the screen may be operated directly by hand, or steam or by a belt. Such a

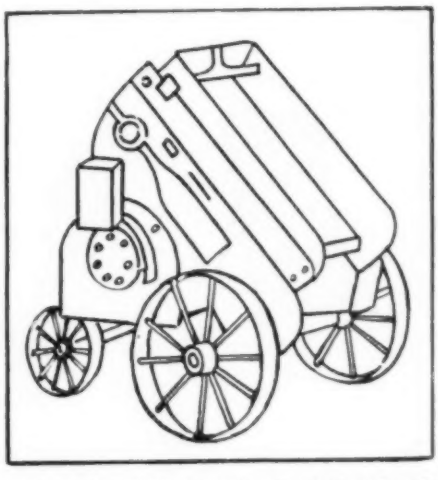


FIG. 7—A SHORT BELT TRAVELING AT HIGH SPEED DISINTEGRATES THE SAND

screen is light. Two men can transport it easily. It gives excellent service, particularly when operated by compressed air, which jolts it in a manner not readily simulated by any other means.

Fig. 4 shows a compressed air operated screen made entirely of metal. This screen consists of a tripod *P*, made of flat iron bars, the lower ends of which terminate in cast iron balls having a diameter of 150 millimeters (6 inches). The tripod carries a compressed air motor *M*, which drives a circular frame from 18 to 30 inches in diameter, supported by the two rods *L*. An ordinary foundry riddle *T*, having any desired mesh may be placed in the frame. The rods *L* sometimes are replaced by thin steel strips which act as springs. The hose *V* is provided with a valve for starting and stopping. This outfit weighs around 175 pounds with a ½-inch mesh screen.

Screens similar to the two preceding types, are operated by an electric motor, either through connecting-rod and crank, or by a cam.

Power Riddles

Fig. 5 shows a portable rotary sand sifter, electrically driven. It consists of a steel platform *A*, mounted on wheels and carrying the drum *T* with six panel screens, driven by the electric motor *M* through the reduction gear *R*. The drum consists of two end-plates mounted on the overhanging shaft, the outer plate having an opening through which the sand is introduced with a shovel. The two plates are connected through the crossbars which carry the metal screens. One of the panels is removable for cleaning out the residue. A plug and cable connect the motor to outlet-boxes about the foundry. All that is necessary to put it into operation is to close the switch if it is a three-phase current supply, or operate the starting rheostat in case of direct current.

The screen shown in Fig. 6 consists of a motor with a vertical shaft, connected by means of yoke to a circular screen. This screen is suspended and due to the action of the shaft, it is shaken as soon as the motor is started up.

In America a machine shown in Fig. 7, has been developed for large quantity production which throws the sand on a heap with great force and removes all foreign substances. It consists of an endless belt armed with points, revolving on two drums, one of which is coupled to a high-speed electric motor. The sand is scattered, well broken up and aerated.

In America large machines equipped with revolving curved blades attack a heap of sand from one end. As they go forward the blades engage the sand and throw it backward. This machine is used in foundries where quantity production is handled and where the molding floors are large and placed in a straight line.

A comprehensive illustrated description of the many types of mechanical equipment employed for preparing sand in American foundries was published in THE FOUNDRY, Dec. 1, 1926. The list includes three variations of the machine described in the second preceding paragraph, besides many other types of machines installed in large and small plants.

Sand for large molds is wetted then mixed and screened on the floor according to the methods just considered. Part of this sand is carried to the sand preparing department by wheelbarrows or carts for conversion into facing sand. In some foundries the molds are shaken out near the sand preparing department.

Some foundries only make ordinary castings and only screen floor sand after having supplemented it with some semi-strong new sand. Others prepare mechanically the sand they use for facing the mold. The facing sand, may be prepared by either one of the following methods:

1. Dry sand preparation, in which the operations are performed after a preliminary drying of the materials.

2. Preparation in a wet state which treats the sand directly without any previous application of drying methods.

The dry method of preparing molding sand includes the following different operations: Drying, crushing, screening, wetting, mixing, dry rubbing, cutting.

In the small and average foundries, the new fat sand is dried on top of stoves. Each day the dry sand is removed from the side of the crushers feeding-hopper and a certain quantity of fresh sand is spread on top of the stoves. It is introduced through a door located at the level of the floor of the stove. If the amount of fine sand thus obtained is insufficient for the requirements of the foundry, a drying chamber is built on top of the stove, and provided with steam or hot-water coils.

Table II

Sample of American Molding Sands

	Opener	Binders		Of no particular molding value			Texture and finish		
	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	Alkalies	SO_3	Fineness	
Tennessee	92.96	3.10	4.92	.....	.....	0.26	.....	98.58	Fine Weak Open
Long Island, N. Y.	89.16	2.92	4.66	.....	0.33	0.33	.....	0.53	Coarse Weak Open
New York	82.34	4.24	8.50	0.96	0.40	1.79	0.54	1.70	Coarse Strong Open
Indiana	82.50	2.70	8.90	0.16	0.61	1.47	.....	0.50	Coarse Strong Open
Wisconsin	82.87	2.67	8.45	0.80	0.89	1.00	trace	57.3	Medium Strong Open
Indiana	79.66	9.74	3.36	1.34	0.68	2.50	.....	78.34	Medium Strong Open
So. Carol'na	79.30	4.10	10.70	1.19	1.29	.....	.....	.....	Strong Open
Kentucky	76.16	4.24	12.02	.....	0.72	1.21	.....	.....	Open Fine Strong
Ohio	77.14	6.44	9.20	trace	0.91	1.10	.....	.....	Strong Open
Illinois	75.70	13.46	3.00	0.60	1.08	2.15	0.19	0.60	Coarse Strong Close
Illinois	56.80	5.09	14.43	6.40	5.60	3.15	0.14	70.24	Fine Strong Very Close

Publishes Abstracts

The American Society for Testing Materials research committee on fatigue of metals recently published a pamphlet containing abstracts of articles on the fatigue of metals under repeated stress which have appeared in the technical press from July 1, 1928 to June 30, 1929. The pamphlet contains 27 pages and gives 53 abstracts.

In 1928 primary aluminum to the value of $47,899,000 was produced in the United States. During this time secondary metal valued at $22,083,600 also was produced.

Cleveland Public Auditorium Where Exhibits and Technical Meetings Will Be Held

A.F.A. Plans for Cleveland

Convention and Exhibition

CLEVELAND, the second largest foundry center in the country, will act as host to the members of the American Foundrymen's association when the annual convention opens in the public auditorium on May 12. This is the fourth time in the history of the American Foundrymen's association that Cleveland has been honored by the association. The first Cleveland convention was held in 1906, just ten years after the organization of the association. The second meeting on the shores of Lake Erie was held in 1916, and the third took place in 1923, shortly after the completion of the large public auditorium.

Selection of the Cleveland public auditorium for the thirty-fourth annual convention and the twenty-third exhibit of foundry equipment, machines and supplies was made primarily because of exceptional facilities offered for housing the annual gathering of the American Foundrymen's association. The auditorium and annex together afford accommodations for practically unlimited exhibit requirements in the way of space and power and rooms for meetings.

The management and exhibitors are planning to take full advantage of these unusual facilities, and they are promising to make the 1930 show the most outstanding foundry display ever held. The desirable location of the auditorium will, in itself, do much toward making the meeting an ideal one both from the standpoint of the visiting foundrymen and the exhibitors.

Cleveland's hotels will accommodate the country's largest conventions, and most of these hotels are within easy walking distance of the auditorium, situated in the downtown section of the city. This, and the fact that all convention sessions will be held in the meeting rooms of the auditorium, will greatly conserve the time of both members and guests.

Exhibits will be thrown open at noon on Monday, May 12, in both auditorium and annex. The closing hour on Tuesday, Thursday and Friday will be 5:00 p. m. However, arrangements have been made to hold all exhibits open on Monday and Wednesday until 10:00 p. m. This is being done for the accommodation of those who desire to take advantage of both the morning and the afternoon convention sessions, and the plant visitations which have been scheduled.

Tentative Program

Monday, May 12

10:00 a. m. Exhibition Opening.
2:00 p. m. General Opening Meeting and Business Session.
4:00 p. m. Shop Operation Courses.

Tuesday, May 13

10:00 a. m. Foundry Costs (Nonferrous and Gray Iron).
Malleable Founding.
12:15 p. m. Malleable Foundry Round Table.
2:00 p. m. Cast Iron Founding.
Nonferrous Founding.
4:00 p. m. Shop Operation Courses.

Wednesday, May 14

10:00 a. m. Management.
12:15 p. m. Nonferrous Round Table.
2:00 p. m. Sand Control.
4:00 p. m. Shop Operation Courses.

Thursday, May 15

10:00 a. m. Steel Foundry Practice.
Apprentice Training.
12:15 p. m. Steel Foundry Round Table.
2:00 p. m. Nonferrous Foundry Practice.
Gray Iron Foundry Practice.
4:00 p. m. Shop Operation Courses.

Friday, May 16

10:00 a. m. Materials Handling and General Foundry Practice.
5:00 p. m. Exhibition Closes.

An always-welcome feature of convention week is the exhibitors' dinner, which is scheduled for Tuesday evening, May 13. Another annual affair is the American Foundrymen's association subscription banquet, to be given on Thursday evening.

An added feature of the exhibit this year will be an educational and technical display, which will be housed in the large, closed corridor connecting the auditorium and the annex. This exhibit will contain displays prepared by various committees of the American Foundrymen's association and will include sand testing apparatus, apprentice contest material, exhibits of many engineering schools, castings, refractories and a metallurgical and physical testing laboratory.

The tentative program for the convention includes sessions on metallurgy, engineering practice, management and practical shop operation. Because of the varied interests of the members and guests attending the meeting, the sessions this year will be organized as to limit the subjects covered at any one meeting. However, there will be a sufficient number of sessions to cover all the important phases of foundry practice.

Sessions on general management problems, apprentice training and foundry costs will be held under the management section. Metallurgical practices in the four major branches of the industry will be brought out in the regular sessions, organized on lines similar to those in force at past conventions.

The informal roundtable luncheon discussion meeting, of considerable interest every year, will again be held at the Cleveland convention. Three such roundtable sessions are scheduled, covering malleable, steel and nonferrous foundry subjects.

The shop operation courses, so popular at the past two annual meetings, will be broadened this year to include a course on the fundamentals of nonferrous shop practice. In addition, the two courses held in 1929 on gray iron and steel will be continued. They are being organized essentially for the practical shop man and will be conducted by leaders thoroughly familiar with shop problems. Each course will consist of three or four sessions, beginning at 4:00 p. m. on the days scheduled.

All convention sessions will be held in the excellent meeting rooms available in the auditorium. The tentative schedule of sessions as at present organized is given in the accompanying box.

A number of authors new to American Foundrymen's association programs will read papers on various foundry subjects at the 1930 convention. A partial list of those who have signified their intention of submitting papers, and the subjects to be covered by each, is as follows:

"Electric Gray Iron Melting," B. C. Beach, Beach Foundry Ltd., Ottawa, Canada; "Enameling Properties of Cast Iron as Affected by Sands Used," C. J. Scullin, Tucker-Scullin Corp., St. Louis; "Use of Briquetted Borings in the Cupola," F. J. Walls, Wilson Foundry & Machine Co., Pontiac, Mich.; "Personnel Training," Dr. Harry Meyer, Frigidaire Corp., Dayton, O.; "Cleanliness and Neatness of the Foundry as a Business Asset," J. J. Carroll, G. & C. Foundry Co., Sandusky, O.; "Application of Ingot Metal to Production of Brass and Bronze Castings," W. Romanoff, H. Kramer Co., Chicago; "Effect of Pin Hole Porosity on Properties of Sand Cast Aluminum Alloys," E. M. Gingerich and H. J. Rowe, Aluminum Co. of America, Pittsburgh; "Heat Treating Cast Iron," F. J. Walls, Wilson Foundry & Machine Co., Pontiac, Mich.; "Carbon and Sulphur Equilibrium in Cupola," J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala.; "Effect of Prolonged Heating at Various Temperatures on Cast Iron," R. S. MacPherran, Allis-Chalmers Mfg. Co., Milwaukee; "Steel Melting Problems," Geo. Batty, Steel Castings Development bureau, Philadelphia; "Factors Affecting Machinability of Malleable Iron," H. A. Schwartz, National Malleable & Steel Casting Co., Cleveland; "Duplexing Process of Producing Malleable Iron," B. R. Mayne, Saginaw Products Co., Saginaw, Mich.; "Foundry Sand Control from Producers' Point of View," W. W. Kerlin, Enterprise Sand Co., Conneaut, O.; "Gating and Risering of Castings," E. Ronceray, Bonvillain & Ronceray, Choisy-le-Roi, France; "Wear Testing of Cast Iron," R. M. Allen, American Car & Foundry Co., New York; "Technical Control of Brass Foundry Mixtures," H. C. Loudenbeck and A. M. Ondreyco, Westinghouse Air Brake Co., Wilmerding, Pa.; "Induction Furnaces for Ferrous and Nonferrous Foundries," Manuel Tama, Berlin, Germany.

Linde Air Products Co., 30 East Forty-second street, New York, recently has opened a new oxygen plant at 60 Knott street, Portland, Oreg. The plant started operations Nov. 19. A. D. Davis is superintendent of the new plant and D. F. Fox with headquarters at 114 Sansome street, San Francisco, is district superintendent.

Close Old Casting Shop in Eastern City

After an active career of 117 years the venerable old plant known for many years as the Key Highway foundry, Baltimore, and operated for the past 35 years by Levering Bros., has been closed down permanently. A considerable part of the materials and equipment has been moved to a modern plant erected some years ago by the same company in the southwest section of the city. The old foundry originally was known as the Ramsey foundry and began operations by manufacturing cannon balls for the American forces in the war of 1812. Part of the output went to Fort McHenry, about a mile distant where for three days, Sept. 12, 13 and 14, 1814, cannon balls and bombs were thrown with great force and earnestness at the British fleet. The flare of the guns and the bombs bursting in air inspired one eye witness, Francis Scott Key to write the words of what later came to be adopted as the national anthem, The Star Spangled Banner. Some of the old cannon balls still are preserved and exhibited at Fort McHenry.

Munitions of war were manufactured at the Ramsey plant during the Civil war, but since that time the output of the foundry has gone into other channels. About 35 years ago the plant was taken over by Levering Bros. sash weight manufacturers. Decision to abandon the old foundry came soon after the company had joined the National Sash Weight Co., an association of foundrymen specializing in the production of cast iron sash weights. In addition to Levering Bros., Baltimore, the association includes E. E. Brown & Co., Darby, Pa.; Borough Foundry Co., Brooklyn, N. Y.; Carteret Foundry Co., Jersey City, N. J.

Publish Reprint

The American Society for Testing Materials recently has published an 118-page reprint of papers and discussion presented at its June, 1929, meeting held at Atlantic City, during the symposium on the physical properties of cast iron. The reprint contains 11 papers relating to the different physical properties of cast iron, by Bolton, MacPherran, Rother and Mazurie, Coyle, Kommers, Bornstein, Boegehold, Lowry and Forrest. This discussion contains additional data that will be of interest to foundrymen and others interested in the study of cast iron.

Compares Properties of Various ALLOY STEEL CASTINGS

By David Zuege

A VERY marked increase in the tonnage of steel castings used in the United States occurred during the World war. The reasons for this are obvious when one considers the varied uses of steel castings in war time. The result was an unprecedented demand for greater production which caused many foundries to enlarge their capacities.

There was not only a demand for greater production, but also for increased quality, and the conditions which the castings were required to meet were analyzed more closely and definite physical properties were specified. There had been a trend toward standardization prior to that time, beginning about 1902, at the time the American Society for Testing Materials was organized.

Demand Decreased

Steel casting specifications in 1902 were far below those now prescribed. Typical specifications called for a minimum tensile strength of 60,000 pounds per square inch, and a minimum elongation value of 10 per cent, with no limiting values for yield point or reduction of area.

Even with these low values, manufacturers at times had difficulty in meeting the requirements, and were required to give the castings long and repeated treatments with little success. However, these failures often were obscured by the demand for quantity production in the industry.

Effect of Alloys

PRODUCTION of alloy steel castings of high strength coupled with ductility, has increased since 1920. A discussion of the effect of various alloys and combinations with physical test and chemical analysis is contained in this article by David Zuege, research engineer, Sivyer Steel Casting Co., Milwaukee. This is the first of two articles on the subject, the final section of which will appear in an early issue. It is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association.

When the war ended the demand decreased. The bookings of steel castings as given by the department of commerce dropped from 105 per cent of the rated capacity in 1918 to 41 per cent in 1919, 68 per cent in 1920, and 26 per cent in 1921. Such a decrease in demand meant the elimination of the weaker producers and the survival of those who could produce castings of excellent quality at reasonable prices. At the same time consumers were making greater demands than ever before for quality. In the machinery field, higher speeds prevailed, in the oil fields, wells were being dug deeper, and in the power field greater pressure and higher temperatures were being used. These are typical instances of a general trend which, with the decrease in demand for steel castings at that time, were responsible for numerous investigations of the adaptability of various alloying elements to cast steels. This research has resulted in a steady increase in the percentage of alloy steel castings made since 1920.

Classifies Alloy Steels

Alloy cast steels have been classified into three groups by Frank, *Transactions*, American Foundrymen's association, vol. 36, page 120, 1929: steels of high physical properties such as tensile strength and ductility, or resistance to impact, abrasion, fatigue, or distortion; steels with extraordi-

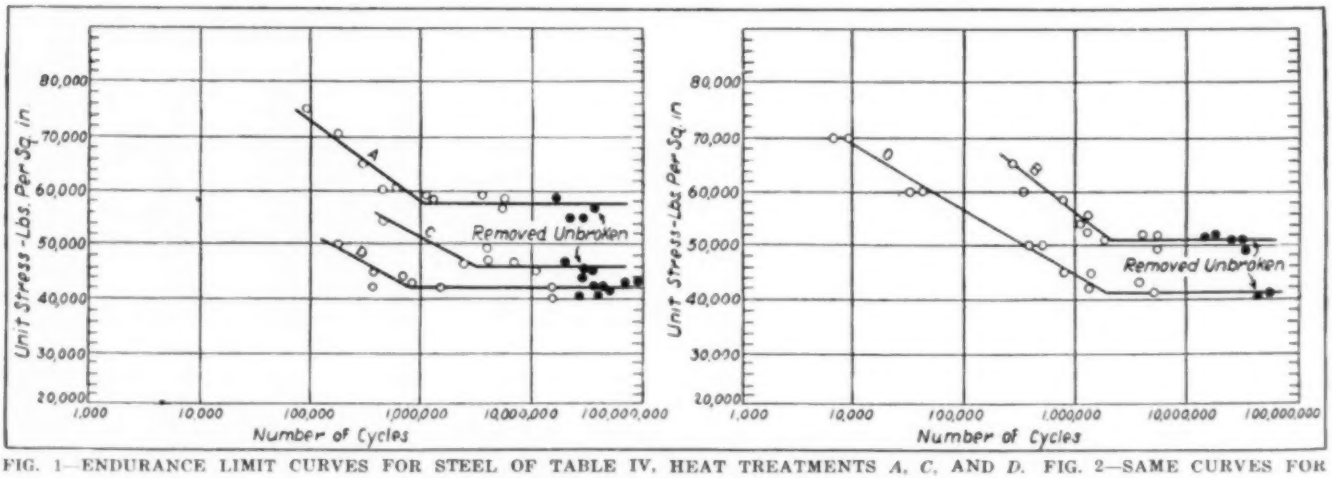


FIG. 1—ENDURANCE LIMIT CURVES FOR STEEL OF TABLE IV, HEAT TREATMENTS *A*, *C*, AND *D*. FIG. 2—SAME CURVES FOR STEEL OF TABLE IV, HEAT TREATMENTS *O* AND *B*

nary properties, such as resistance to corrosion and magnetic permeability, and heat resisting steels. Although all three classes have contributed to the increase in the amount of alloy steel castings made in recent years, the data presented in this article are confined to steels of the first class with the further restriction that all of the steels investigated are machinable in the normalized or annealed condition.

The alloying elements most used for cast steels of that type or chromium, nickel, manganese, vanadium and molybdenum, or various combinations of the above. Chromium is one of the leading alloying elements. Although it often is used in conjunction with other elements, a simple chromium steel may be given properties exceeding those of a plain carbon steel. Chromium has no scavenging power, but is used as a true alloying element. It combines chemically to form either a chromium carbide, which dissolves in the cementite, or forms a complex carbide of chromium and iron. These carbides are extremely hard. Since the hardness which can be procured is dependent upon the carbides formed, the amount of carbon as well as the chromium content is an important limiting value for such steel.

Gives Effect of Chromium

However, chromium increases the hardness not only because of the hardness of these chromium carbides, but because it aids in the retardation of the austenite transformation. Cementite containing chromium goes into solution with difficulty, thus raising the critical points on heating, and once in solution does not separate out to form pearlite as readily as ordinary cementite does on cooling. It helps to prevent the transformation of the austenite in rapid cooling, thus increasing hardness of the surface and also depth of hardening.

The chromium steels have a fine structure, which produces higher static strength than the straight carbon steels, with little loss in ductility.

Unlike chromium, nickel dissolves in iron in all proportions. It is found dissolved both in the free ferrite and in the pearlitic ferrite of hypo-eutectoid cast steels. The presence of this iron-nickel alloy tends to retard the austenite-pearlite transformation in cooling through the critical range and its effect upon the physical properties of the steel is due not only to the added strength imparted to the ferrite, both free and pearlitic, but also to the fact that the iron nickel alloy tends to retain the harder and stronger stages of the austenite-pearlite transformation in the steel.

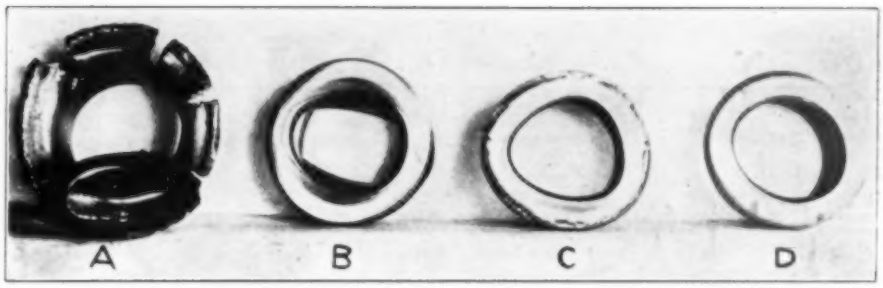


FIG. 3—HORIZONTAL VIEW OF COMPRESSED CYLINDERS AFTER TEST

Because nickel produces beneficial properties in the ferrite, it is a useful element to use in combination with chromium or other elements which impart added properties through their influence upon the cementite.

When manganese is added to a steel in an amount in excess of that required either for deoxidation or for the conversion of the sulphur to manganese sulphide, it must be considered as a true alloying element. Manganese forms a complex iron manganese carbide, and a solid solution of manganese and iron. It has a favorable effect upon the physical properties of the pearlitic steels, causing high strength and excellent ductility.

Vanadium is a powerful deoxidizing agent and it is believed that the beneficial effects obtained through its use are due largely to its elimination of impurities, although it also forms complex carbides. It is used largely in heavy irregular shaped castings in which it raises the ratio of yield point to tensile strength with no decrease in ductility.

Swinden *Journal*, Iron and Steel institute, Carnegie scholarship memoirs, vol. 5, 1913, has concluded that in the absence of chromium or excess manganese, molybdenum is diffused throughout the ferrite of the steel, to which it gives greater hardness. When chromium or an abnormal manganese content is present with the molybdenum, double carbides are formed, producing greater hardness and strength. He found that in steels containing 1 to 8 per cent molybdenum, a definite compound of molybdenum with the iron was formed in cooling through the critical range. This compound assumes a

Table I

Physical Properties of Vanadium Steel

0.35-0.45 C. 0.18-0.25 VA. CAST STEEL

	Full annealed	Range of properties after various heat treatments
Tensile strength, in pounds	85,000	90,000 to 160,000
Yield point, in pounds	50,000	60,000 to 140,000
Elongation in 2", per cent	22	20 to 6
Reduction of area, per cent	40	45 to 12
Brinell hardness number	180	190 to 450
Scleroscope hardness number	25	25 to 55

Table II

Physical Properties of Manganese Steel

Of 0.27-0.37C. 1.35-1.55 MN. CAST STEEL

Heat	C.	Mn.	Si.	Yield point, lbs. per sq. in.	Tensile strength lbs. per sq. in.	Elongation in 2", %	Reduction of area, %	Brinell hardness	Charpy Ft. Lbs.
036	0.31	1.32	0.40	62,500	97,850	27	53	212	13.3
036A				54,550	87,650	30	57.3	183	14.2
038	0.33	1.50	0.38	61,200	103,500	23.5	49.5	212	11.2
038A				51,200	89,100	28	58.3	183	13.3
049	0.32	1.42	0.40	58,300	92,000	26	45.4	192	13.9
049A				55,050	83,250	31.5	55.7	166	16.4
098	0.32	1.54	0.48	64,250	110,200	22.5	47.8	228	15.1
098A				59,950	95,850	24	54.4	202	14.5
155	0.37	1.44	0.28	61,450	98,800	20	32.8	202	4.1
155A				58,200	93,600	24.5	49.7	170	4.5
167	0.33	1.46	0.31	61,350	95,800	25.5	49.3	192-	13.3
167A				51,950	86,350	32.5	57.8	183	18.3

Bars having no suffix were held at 1650° F. in shop annealing furnace for three hours, then cooled in air.

Bars having the suffix A were drawn for three hours at 1250° F. after receiving individual air quench from 1650° F.

Size of coupon, 1 x 1 x 6 inches.

FIG. 4—VERTICAL VIEW OF COMPRESSED CYLINDERS AFTER TEST

fixed state when cooled rapidly and breaks up slowly on drawing back after the quenching operation. Sargent *Proceedings*, American Society for Testing Materials, vol. 20, 1920 found the same conditions in steels containing 0.25 to 0.50 per cent molybdenum.

The retention of such a compound through a wide range of drawing temperatures explains the fact that after quenching the molybdenum steels retain their high hardness and strength values through a wide range of draw temperatures. Since molybdenum steels require a slower cooling rate to produce definite strength and hardness values than most other steels, the strains occurring in these steels after heat treatment should be low.

The steels listed under the first group of the classification of cast alloy steels previously referred to may be reclassified into three sub-groups: Cast alloy steels for general uses where fairly high physical properties are desirable but where no especially severe service conditions are encountered. These steels are usually given no heat treatment other than that given ordinarily in the foundry, although individual heat treatment causes a further improvement of properties; cast alloy steels for specific purposes in which definite physical properties are developed through proper heat treatment of individual castings; cast alloy steels for extremely severe service conditions, requiring exceptional physical properties, but where the design of the casting is such as to make liquid quenching impractical.

Since the better physical properties obtainable in the second and third groups are secured at an additional cost, the problem confronting both manufacturer and consumer of steel castings is the selection of that steel which will most successfully withstand the required service at a minimum total cost. It is believed that a study of the physical properties obtained on steels of these three sub-groups is best understood by comparing their relative merits in the absence of direct service tests. Values obtained from typical steels of each group will be given.

The two steels which occupy prominent positions in the first sub-group are vanadium steel and 1.20 to 1.60 per cent manganese steel.

Vanadium steels have been used to a considerable extent in castings where an exceptionally clean metal was desired or where castings of intricate design were required, since vanadium does not confer marked air hardening properties. It was believed that vanadium imparted to steels the ability to resist repeated stress, but some recent investigators believe that its importance in this respect has been exaggerated. Vanadium cast steels having a carbon content of 0.35 to 0.45 per cent and 0.18 to 0.25 per cent vanadium will develop the physical properties given in Table I.

The use of 1.20 to 1.60 per cent manganese steel for castings requiring

Table III

Comparative Tests of Carbon and Manganese Cast Steel

.40-.50 C. AND 1.25-1.60 Mn.

Cylinder Number	Kind of Steel	Size of Cylinder	Actual Load, lbs. per sq. in. Yield Point	Actual Load, lbs. per sq. in. Ultimate	Stress in lbs. per sq. in. Yield Point	Stress in lbs. per sq. in. Ultimate	Height of cylinder when first crack occurred: Actual Inches	Height of cylinder when first crack occurred: Per Cent of Original
A*	.40-.50 C.	1.5" x 1.312" ID x 1.5" OD	18,760	38,650	54,100	92,900	1.06	70.5
C*	.40-.50 C.	1.5" x 1.312" ID x 1.5" OD	19,000	38,640	45,700	92,900	1.03	69.7
H*	.40-.50 C.	3" x 1.312" ID x 1.5" OD	19,390	38,230	46,500	92,000	2.37	79
B†	Mn. C.	1.5" x 1.312" ID x 1.5" OD	28,880	46,550	69,500	112,000	0.37	24.6
D†	Mn. C.	1.5" x 1.312" ID x 1.5" OD	27,900	45,330	67,550	109,000	0.42	28
E†	Mn. C.	3" x 1.312" ID x 1.5" OD	27,130	44,510	65,250	107,000	1.5	50

**Analysis:* C., 0.43; Mn., 0.72; Si., 0.45. Heat treatment: Held three hours at 1650° F. Cooled in furnace.
†Analysis: C., 0.31; Mn., 1.56; Si., 0.41. Heat treatment: Held three hours at 1650° F. Cooled in air.

Table IV

Manganese Carbon Steel, Oil Quenched and Drawn

Analysis: C., 0.35; Mn., 1.42; Si., 0.40.

Heat Treatment	Yield Point, lbs. per sq. in.	Tensile Strength lbs. per sq. in.	Elongation in 2", per cent	Reduction of Area, per cent	Brinell Hardness	Scleroscope Hardness	Charpy Impact, Ft. Lbs.	Endurance Limits, lbs. per sq. in.
O	63,500	101,200	23	47	228	35	8.6	41,000
	60,200	101,000	22	43.6			8	
A	100,950	144,300	8	22	321	50	2.8	57,000
	Bar broke at shoulder.						2.8	
B	95,050	132,350	11.5	33.8	286	45	7.8	51,000
	89,650	130,850	15	34.7			8	
C	72,000	100,400	22	51.7	228	43	14.4	46,000
	73,900	102,800	21	49.7			14.4	
D	57,400	100,450	24.5	50.6	187	35	23	42,000
	58,900	96,950	23	54			24.2	

Heat Treatments:
O normalized two hours at 1650° F.
A normalized two hours at 1650° F. Held two hours at 1550° F. Quenched in oil; drawn at 600° F.
B normalized two hours at 1650° F. Held two hours at 1550° F. Quenched in oil; drawn at 900° F.
C normalized two hours at 1650° F. Held two hours at 1550° F. Quenched in oil; drawn at 1200° F.
D normalized two hours at 1650° F. Held two hours at 1550° F. Quenched in oil; drawn at 1350° F.
Size of coupon, 1" x 1" x 6".

a combination of high strength and high ductility has increased in recent years. Hall has done considerable work in the development of that type of steel and has published representative physical properties of the material. The values given in Table II are taken from tests on routine heats and are in substantial agreement with those of Hall. These data show that the effect of the draw at approximately 1250 degrees Fahr. is to increase the ductility and impact values but to decrease the yield point and tensile strength. The physical properties both with and without the draw are satisfactory and the choice of the treatment is dependent upon the use of castings.

The superiority of this type of steel over a typical 0.40 to 0.50 per cent carbon steel is shown in an interesting manner by some tests on hollow steel cylinders shown in Figs. 3, 4 and 5, the results of which are tabulated in Table III. The tests were made on cylinders machined from solid cast steel blocks to the size shown in Table III and were tested to destruction in a testing machine.

Compresses Steel Cylinders

C and *D* in Figs. 3 and 4 show respectively as 0.40 to 0.50 per cent carbon and a manganese carbon cylinder originally 1.5 inches in height compressed to a height of 1.06 inches, at which height cracks occurred in the 0.40 to 0.50 per cent carbon cylinder. *A* shows cylinder *C* compressed to a height of 0.75 inch, at which complete rupture occurred. *B* shows the manganese carbon cylinder compressed to a height of 0.5 inch, at which height the first cracks occurred. *H* and *E* in Fig. 5 show the relative deformation obtained on the 3-inch cylinders of both 0.40 to 0.50 per cent carbon and manganese carbon before cracks appeared. The manganese carbon cylinders had not only better ductility as shown by the photographs but greater strength.

Although the greater proportion of the manganese carbon steel is used in the normalized annealed, or normalized and drawn condition because of the excellent results secured by these treatments, a considerable increase in the various physical properties may be secured by resorting to a liquid quench.

Table IV gives the results obtained by drawing 1 x 1 x 6-inch test bar coupons of a typical manganese carbon heat at various temperatures after an oil quench from 1550 degrees Fahr. These data show that the liquid quench followed by a low draw produces an increase in strength, hardness, and endurance limit over the normalized steel, and a decrease in ductility and resistance to shock. As the draw temperature is increased, a corresponding increase occurs in ductility and shock resistance, with a decrease in strength and hardness and endurance limit. Figs. 1 and 2 show the results of the fatigue tests which were made, using the R. R. Moore fatigue testing machine.

Makes Textile Machinery

(*Concluded from Page* 93)

gangways and the metal is distributed by hand ladles.

Castings are cleaned in a battery of 12 rectangular tumbling barrels made by the Whiting Corp., Harvey, Ill., and in a large sandblast chamber with revolving table made by the Pangborn Corp., Hagerstown, Md. Also in a smaller chamber made by the same company in which a hose is employed. Each of the tumbling barrels is driven by an individual motor unit. The necessary grinding

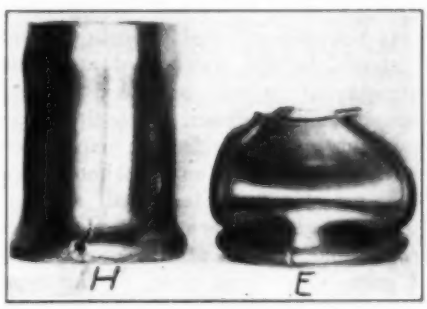


FIG. 5—RELATIVE DEFORMATIONS OF CYLINDERS AT WHICH CRACKS APPEARED

is done on a battery of nine double wheel stands made by the Norton Co., Worcester, Mass.

The various grinding and cleaning units are piped to mains beneath the floor which carry the dust to a dust arrester chamber located in the second story of a building situated 20 feet to the north of the foundry. The dust from this chamber falls through chutes into trucks that are backed in through the door on the ground floor. Six exhaust fans made by the Sturtevant Co., Boston and located in an adjoining room furnish the necessary air current for drawing the dust away from the cleaning room.

Nonferrous castings are made in the center section of the south bay of the foundry. Molds are made on the bench and on a battery of molding machines supplied by the Osborn Mfg. Co., Cleveland. This company also furnished practically all the machines used on the side floors in the gray iron section of the shop. Aluminum, brass and bronze are melted in four electric furnaces made by the Detroit Electric Furnace Co., Detroit.

Cores are made in a section of the adjoining bay and are loaded on racks and dried in four electrically heated ovens, supplied by Young Bros. Co., Detroit. Sand for the cores, also facing sand for the molds, is prepared in a 6-foot mixer made by the National Engineering Co., Chicago. This device is installed in one of the large concrete chambers under the stock floor in an adjoining building referred to previously. Core and molding sand of various grades are stored in these bins and the required quantities are brought to the mixer on industrial trucks. The same medium is employed to distribute the prepared sand afterward to the various molding and core making station.

Leaves Location Rich in Foundry History

Mackintosh-Hemphill Co., Pittsburgh, has moved its general offices and engineering department from the original site at the foot of Twelfth street, which it had occupied for 70 years, to the Point building at Penn avenue and Water street.

This company has played an important role in the development of the steel and nonferrous industries through its engineering and production work in plant and rolling mill equipment. It traces its history back farther than 1859 when James Hemphill, Dr. W. S. Mackintosh and N. F. Hart acquired a small shop at the site just relinquished by the present company. In 1803, the Pittsburgh Foundry, the first foundry in Pittsburgh, was founded by Joseph McClurg. A. Garrison & Co. succeeded to its ownership in 1865. Calvin Adams established another foundry in 1837 which successively was known as the Jarvis Adams Co. and the Pittsburgh Iron & Steel Foundries Co. Mr. McClurg and his son Alexander had established the Fort Pitt Works 12 years after their initial foundry venture and in 1878 this company was acquired by James Hemphill and his partners to take care of their increasing business. The A. Garrison Foundry Co., Pittsburgh Iron & Steel Foundries Co. and Woodard Machine Co. were merged with the Mackintosh-Hemphill Co. in 1922. The Woodard company had been established by the Mackintosh company at Wooster, O.

All of these plants are rich in industrial history. The old Pittsburgh Foundry furnished cannon balls for Perry's fleet in 1812. The first locomotive built west of the Alleghenies was a product of the Fort Pitt Works. Civil war ordnance was made at all of the plants.

Railroad Bronzes Are Cast in Permanent Molds

By Henri Marius

REPRESENTATIVE types of railroad specialty brass castings, known collectively as wearing metal, and made in permanent molds at Lenoir Car Works foundries, Lenoir City, Tenn., are shown in the accompanying illustrations. These also include the special iron molds in which the castings are being made, a characteristic feature of which is the standard gate and riser combination used in all molds. Another important feature is that these castings are cast on end and, whenever they have flanges at the ends they are cast with the widest flange up.

Walls Not Machined

Furthermore, the inside walls of the molds are not machine-finished. The only machined parts are the joints of the component parts which must fit exactly and prevent metal leakage or runouts. These features simplify enormously the design and mechanism of these permanent molds by making all top and bottom plates interchangeable, avoiding multiplicity of patterns for each group of castings, and by eliminating expensive machine shop work through the symmetrical division and parting line of each mold.

The economical value of this simplification cannot be appreciated to a full extent unless it be kept in mind constantly that these mechanical molds, outside of the improvement they impart to the quality of brass and bronze castings through their characteristic fine, dense, more homogeneous structure of uniform hardness and greater machinability, must compete effectively in speed and production costs with the most modern molding machines now in operation.

Therefore simplicity of design which provides low first and replacement costs becomes of vital importance and it should be the watchword and first thought of every prospective permanent mold designer. For, simple as it might look, considerable experience and a wealth of foundry knowledge both practical and technical, are required to gate a permanent mold correctly and arrive at standardization of gate, sprue and riser, of the type illustrated herewith. It also must be remembered that in sand molding, losses from faulty gating and risers entail only the loss of molding labor and the indirect costs accrued from the scrapping of the defective castings.

However, in permanent molding, losses from these causes may prove ruinous for, in all probability they mean in every case the complete discarding of the iron molds themselves after considerable money has been spent for materials, pattern and machine shop labor in making the molds. For the benefit of those interested in this process the following general rules evolved from experience in designing permanent molds for a great variety of castings, are suggested. While they may not represent the best or the only successful practice, they follow the author's practice and he feels confident that their application in the spirit, if not to the letter, will prove helpful to many foundrymen.

Gate From the Bottom

Always gate from the bottom because a bottom gate, all things considered, is unquestionably the best for the following reason: The metal from such a gate rises in the mold evenly and gently and *lays* on the walls of the mold. There is no

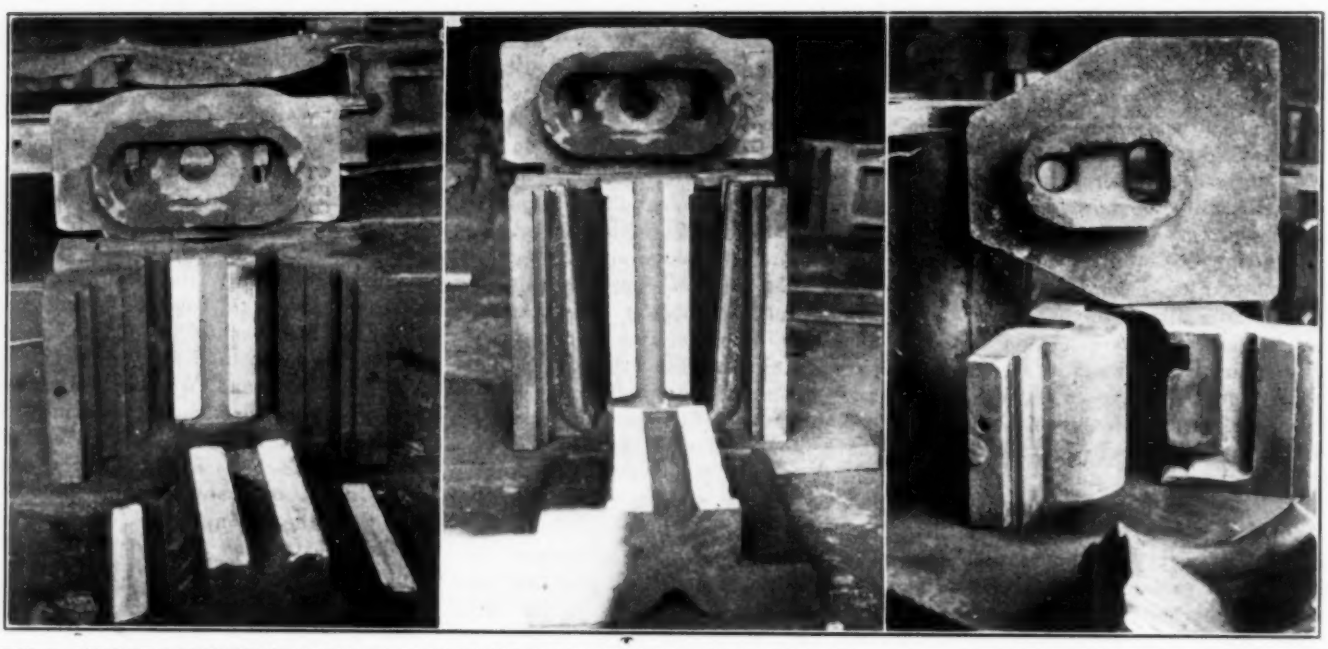


FIG. 1—DUPLEX PERMANENT MOLD FOR A LOCOMOTIVE TRAILING TRUCK BEARING. FIG. 2—SIMILAR MOLD FOR LOCOMOTIVE WEDGES. FIG. 3—PERMANENT MOLD FOR LOCOMOTIVE BACK-END, MAIN-ROD BRASS. ALL MOLDS ARE SHOWN WITH THE STANDARD POURING TOP PLATE

FIG. 4—LOCOMOTIVE CROWN BEARINGS MADE IN IRON MOLDS. FIG. 5—FLANGED CROWN BEARING MADE BY THE SAME PROCESS

splashing with its subsequent formation of cuprous oxide-covered metal globules. It affords a better upward draft for occluded and generated gases from volatile matter in the mold coating. There is no danger of undue erosion and overheating of small areas of the mold walls caused by the rapid and abrupt descent of the hot molten brass. This heating shortens the life of the mold by causing premature fire cracks, and results in defective castings from honeycombed patches of cuprous oxides developed at areas of the mold walls where erosion and heat were excessive.

Allow Reasonable Wall Thickness

Place the gate and riser, whenever possible, in a vertical plane that crosses the casting through its heaviest section and divides it as near as possible into two equal parts. In that way all portions of the mold are filled simultaneously and the metal has less distance to travel into the mold. Therefore, it reaches all corners while hot and fluid, which is always a necessary condition, but more so when castings are of thin section with sharp corners and wide thin flanges. Coincidently the centrally located gate at the heaviest section helps to eliminate several risers as will be shown later.

The sprue or that part of the gate which connects the gate proper to the casting, under any condition, should not be less than 1½ inches long, for the obvious reason that its length controls the thickness of that part of the iron mold which lays between the gate and the casting. Naturally too short a sprue means that the portion of the mold at the junction of the sprue and the casting will become overheated. This causes the casting to show characteristic patches of cuprous oxide on the area directly opposite the gate.

In sand molding the practice is to co-ordinate the size of the gate and risers to the size and weight distribution of the casting. A light casting has a light gate and risers are placed only on heavy sections requiring considerable feeding at solidification. Generally speaking, the speed of pouring remains almost constant throughout the pouring of the casting. With permanent molds the procedure is the reverse, that is, the size of the gate and risers remain the same and the speed of pouring the casting changes.

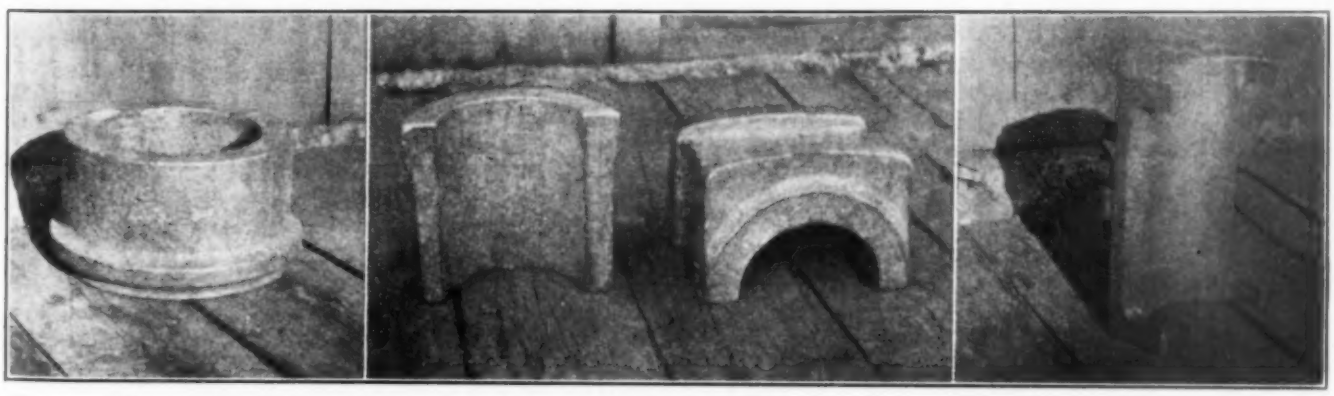
This principle is the main factor in the standardization of the gate-riser combination referred to previously and is of considerable economic value in view of the fact that under ordinary circumstances, the much shorter period of solidification (due to the chilling effect of the iron mold) causes greater shrinkage per time unit. Large heavy castings as the ones illustrated require more and heavier risers than when these castings are poured in sand molds.

However, by pouring the permanent molds rapidly at the start and slowing down gradually as the mold fills up, and by using the centrally located gate opposite the heaviest section of the casting, only one comparatively small riser is necessary to take care of the remaining shrinkage of that portion of the casting opposite the gate and directly under the riser which solidifies last. The heavy section provides the necessary hot metal required to feed the faster setting sides of the casting.

Use Combination Gate

A further economic advantage arising from the application of the principle of pouring speed variation is the substitution of a cast iron pouring cup and riser combination for one of dry sand. The cast iron cup instead of a dry sand one is attached permanently to the iron top plate as illustrated in Fig. 9. Thus the permanent mold becomes an all metal mold eliminating dry sand work.

Another question which has an important bearing in the successful op-



FIGS. 6, 7 AND 8—SHOWING TYPICAL BRONZE CASTINGS MADE IN PERMANENT MOLDS. LEFT—FLOATING BUSHING. CENTER-BACK-END, MAIN-ROD BRASSES, AND RIGHT-TRAILING TRUCK BEARING

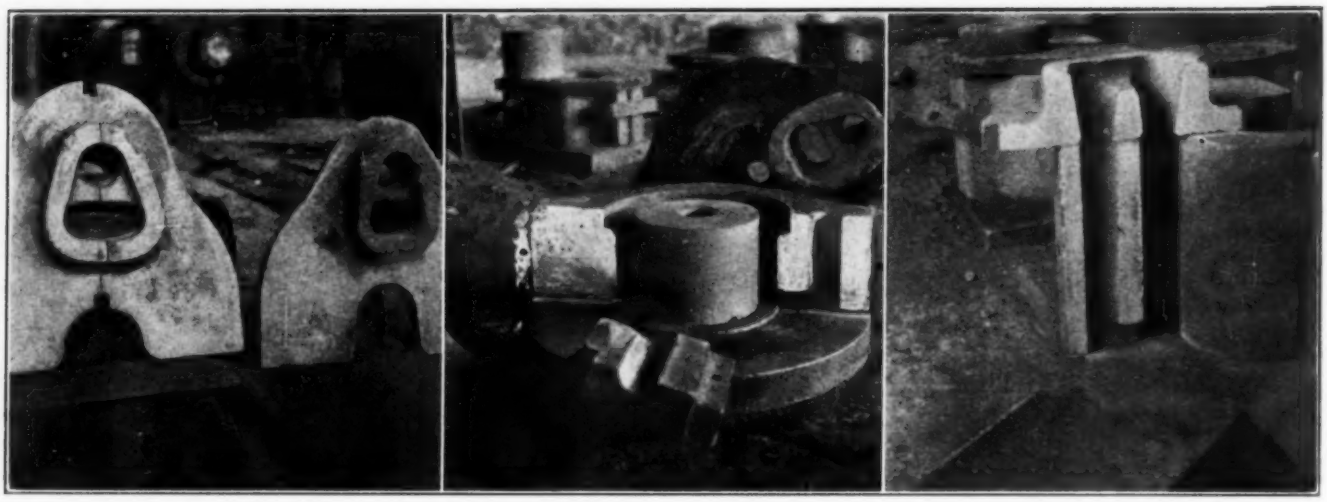


FIG. 9—TYPICAL TOP PLATES FOR PERMANENT MOLDS. THE ONE ON THE LEFT IS ALL IRON AND THAT ON THE RIGHT IS AN IRON PLATE WITH DRY SAND POURING BASIN. FIG. 10—MOLD FOR FLOATING BUSHING. FIG. 11—HALF MOLD AND TOP PLATE OF MOLD FOR CROWN BEARING

eration of permanent molds is that of adaptability of casting design. It has been emphasized that the success of permanent molds depends above all things on the simplicity of mold design. Naturally, one cannot well design a simple mold to a great extent unless the casting itself for which the mold is intended is of simple lines and simple cores are used. The author is of the opinion that the average machine designer suffers from a pronounced tendency to adorn drawings of machine parts to be cast, with a lot of unnecessary curlicues and unjustifiable, expensive corework. In this way he greatly complicates the job of the foundryman who is forced to reciprocate by charging more for his castings. Complicated and unbalanced design and core work often are the cause of terrific internal strains and invisible defects which dangerously impair the strength of the casting.

This will be evident if one considers castings full of sharp corners; of adjoining heavy and light sections with fillets too small; of little crooked cores difficult to anchor or vent that cause losses from core-blows, and which cost a lot more to make and place them in position than the metal saved, etc Millions of dollars are wasted yearly on the part of designing engineers from lack of knowledge of the rudiments of foundry practice or, to put it into other words, through lack of co-operation between the engineering professions and the foundry.

Design Was Changed

Fig. 8 shows a locomotive trailing truck bearing cast in permanent molds. Originally when these bearings were cast in sand, they had two dovetail grooves one on each side running almost the full length and the four prongs were disproportionately sharp. Such a design was causing appreciable difficulties in its adoption to permanent molding. Incidentally, these grooves which were claimed to be absolutely necessary to hold the lining metal in place, were weakening the bearing considerably which caused numerous failures while in service. On investigation it was found that the grooves were not so indispensable and they were eliminated from the design altogether. Then, with a slight change in the shape of the prongs this type of casting became adaptable to permanent molding with vast improvement in quality and strength and substantial economies in cost of production. Some figures on the relative stiffness of three permanent mold cast and three sand cast 6 x 11-inch journal bearings made of the same composition are as follow:

CHILL CAST

Sample No.	Breaking load, pounds
1	45,030
2	47,540
3	45,400
Average	45,990

SAND CAST

Sample No.	Breaking load, pounds
4	35,150
5	36,750
6	37,200
Average	36,366

J. C. Ramage, engineer of tests, Southern Railway System, in whose

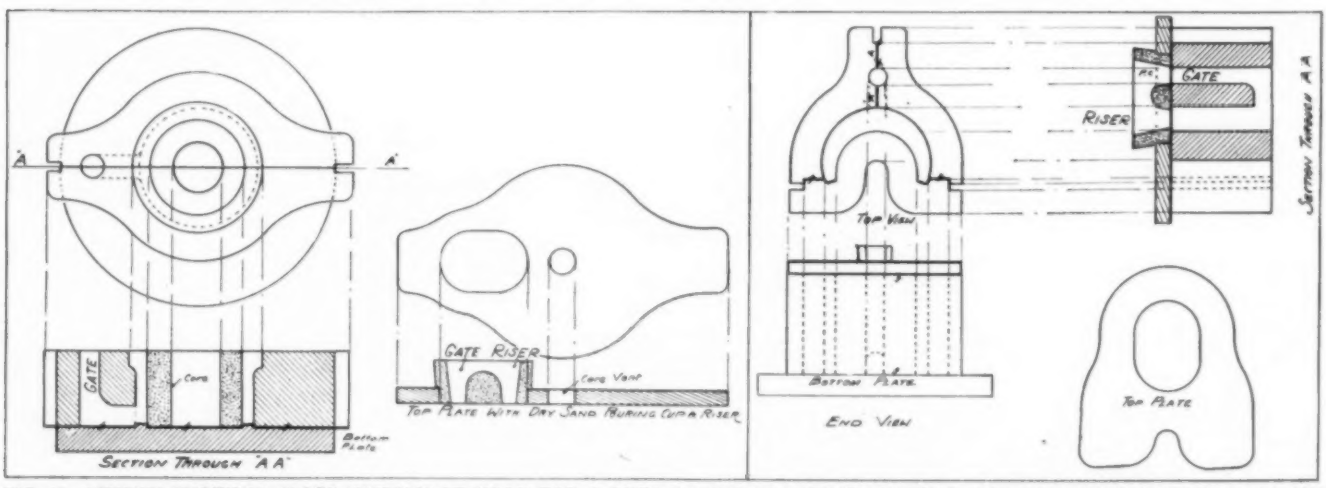


FIG. 12—SKETCH SHOWING CROSS SECTION OF MOLD FOR A LOCOMOTIVE FLOATING BUSHING, AND THE COMBINATION IRON AND DRY SAND POURING BASIN. FIG. 13—CROWN BEARING MOLD CONSISTS OF THE BOTTOM PLATE, FRONT AND BACK OF THE MOLD AND THE TOP PLATE

physical laboratory the bearings were tested, commenting on the results of these tests says, "As you will note the figures indicate the chill-cast bearings to be uniformly about 25 per cent stiffer through the crown than the sand cast bearings. The relative stiffness of the two types of bearings is even greater than this, as even before final fracture the sand cast sprung down to a much greater extent than the permanent mold bearings."

The author has received numerous requests which are difficult to answer intelligently without knowing all the facts and without a first hand study of all conditions in each case. However, insofar as the question of production costs refers to the manufacture of same or similar types of castings dealt with in this article the author through personal experience feels safe in giving a blanket answer and say that all things considered, costs of production with the chill mold process run from 10 to 20 cents less per 1000 pounds of castings produced than that in the sand mold process. However, this depends on foundry personnel, efficiency, mechanical contrivances used in sand handling, and molding machines. While the author is not at liberty to give details of his firm's comparative production costs with the two processes, a few salient facts may be of some benefit to interested parties and help them to draw their own conclusions.

The average life of chill molds shown in the illustrations, is from 1000 to 3000 castings depending on the design and casting weight. Castings with sharp corners and heavy flanges are harder on the molds than others of simpler contours like crown bearings and bushings. Two hundred chill molds representing 160 different patterns are accommodated in a space 30 x 100 feet. A mold never is moved from one place to another unless it has to be replaced by a new one. No skilled mechanic is used in the permanent mold bay. A total force of six men set up, pour, and shake out 130 molds representing an average of 20,000 pounds of metal in eight hours.

Chill mold casting losses from all causes run from 1 to 2 per cent in the author's foundry. The cost of chill molds runs from 2 to 3 cents for each 100 pounds of brass or bronze castings produced. Any composition of brass or bronze alloy can be cast in permanent molds. The easier alloys to be cast are those in which the white metals, particularly lead, are high. However, no appreciable difficulties should be encountered in casting any nonferrous alloy and process of permanent molding, after the pouring kinks are mastered, is easier by far than the sand molding process.

Steel Founders See Good Business

OPTIMISTIC reports for steel foundry business for the first six months of 1930 featured the meeting of the Steel Founders' Society of America, held Dec. 12 at the William Penn hotel, Pittsburgh. Fully 90 per cent of the members attending the meeting believed that business will be good during the first half of the year. Operations as reported are averaging at present about 86 per cent of capacity in the eastern district, 92 per cent in the Midwest and have reached capacity in the Central Atlantic district. During the past ten years operations have averaged between 55 and 60 per cent.

Railroad buying is good with prospects bright for substantial business in the future and demand for steel mill equipment is excellent. Producers of miscellaneous steel castings report the present volume and the future outlook exceedingly favorable. Some slump has been noted in the demand for road building equipment, but it is thought that business in that field will be better in 1930 than in several previous years. Sales prices have been advanced on practically all classes of castings.

John E. Galvin, Ohio Steel Foundry Co., Lima, O., and vice president for the Central Atlantic division of the society, presided at the morning and afternoon sessions. The morning meeting was devoted to the survey of the business situation and the report of Granville P. Rogers, managing director of the society. Mr. Rogers stated that the society recently had been incorporated under the laws of the state of New York. A tentative draft of a set of trade customs has been sent to the research committee for its consideration. It is possible that the committee will have a set of standard trade customs ready to submit to the board at the next meeting of the society, which will be held in Chicago, Jan. 28, 1930. The committee will give special attention to the permissible variation in the weight of the casting and to a standard sales agreement. Consideration also will be given to the benefits of one set of uniform trade customs for all branches of the foundry industry.

It has been decided not to set up a code of fair trade practices at this time, but to recommend the settlement of all disputes that may arise through the American Arbitration association. The society indorsed the principle of arbitration for the settlement of business disputes and authorized the managing director to seek the co-operation of the arbitration association. It was announced that six companies have been accorded membership in the society since the Chicago meeting. The managing director recommended that a special section be set up within the society for the manufacturers of heat, acid and corrosion resisting alloy steel castings.

Immediately following the luncheon for members and guests, George Batty, research director, Steel Castings Development bureau, Philadelphia, delivered an address on "Undeveloped Wealth in the Steel Foundry." Mr. Batty believes that the greatest sources of undeveloped wealth in the steel foundry lie in the personnel, the superintendents and foremen. He called attention to the fact that practical operators and foundry superintendents acquire a tremendous amount of data on foundry operation. However, because of the limitations placed upon the personnel in the drive for production at a set cost, and often due to the great amount of detail that must be carried the superintendent or foreman cannot use the information gathered for the improvement of foundry practice or the elimination of faulty methods. Mr. Batty suggested the employment of a technician, a man with technical training and also practical experience, to correlate and translate the observations of superintendents and foremen and the work of scientists. Intelligent handling of the practical man by the technician will build confidence, develop valuable ideas, and result in the working out of definite formulas.

Meetings of the large castings division and the small castings division followed the general meeting. Both of these sessions were devoted to the discussion of operating reports for the last period, as well as other problems pertaining to the particular branch of the industry. George H. Friesel, United Engineering & Foundry Co., Pittsburgh, was chairman of the large castings division meeting and H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa., presided at the meeting of the small castings division of the Steel Founders society.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

STEEL

Nitrate Is Not Used

QUESTION

We understand that nitrate of ammonia is used to mix with sand for special steel castings. Can you give us any information on this, how it is used, and what it is supposed to do?

ANSWER

As far as we are aware nitrate of ammonia is not used in molding sand for steel castings. Neither can we imagine for what purpose it would be used. Is it possible that someone not familiar with the process of nitriding steel to obtain a hard surface has stated that this is accomplished by using a nitrate in the sand? Unfortunately, the process is not so simple as the steel to be hardened is heated in special furnaces to the required temperature. Then ammonia gas is passed through the hot furnace. The gas is dissociated by the high temperature and the nitrogen of the ammonia unites with the metal at the surface to form an extremely hard skin. This process known as nitriding was developed in Germany, and is used where a hard exterior surface is desired such as the bearing surfaces of a steel automobile crankshaft, etc.

GRAY IRON

Careful Melting Needed

QUESTION

We will appreciate any information on a mixture containing steel scrap for machinery castings. Aso can you supply any information on cupola practice in melting mixtures containing steel scrap?

ANSWER

Machinery castings vary in the analyses generally according to size. They are classed as light, medium and heavy and the following are average analyses for each type: Light, silicon, 2 to 2.50 per cent; sulphur under 0.08; phosphorus, 0.50 to 0.70; manganese, 0.50 to 0.70; medium, silicon 1.50 to 2.0; sulphur, under 0.09; phosphorus, 0.40 to 0.60; manganese, 0.60 to 0.80 per cent; heavy, silicon, 1.0 to 1.50 per cent; sulphur, under 0.10; phosphorus, 0.30 to 0.50; manganese, 0.70 to 0.90 per cent.

Many foundrymen add steel scrap to their mixtures as it gives better wearing properties, greater strength and denser iron. The quantity varies according to the section of the casting, the heavier the section the greater the amount of steel scrap. The scrap additions vary from 15 to 30 per cent, and sometimes up to 50 per cent in extremely heavy castings.

The use of steel scrap additions entails first of all, good cupola practice. The bed must conform to the principle laid down by Moldenke and other foundry investigators, that is it should be from 24 to 30 inches above the top of the tuyeres. The bed should be ignited well so that when the blast is turned on, iron will melt over the total bed surface and come down in from 8 to 10 minutes.

Steel scrap cannot be added indiscriminately. The mixtures must be balanced properly to obtain the best results. Steel contains practically no silicon and this fact must be kept in mind. Ferromanganese or high manganese pig should be added to care for any increase in sulphur and act as a deoxidizer. Probably more coke will have to be used to obtain good hot iron as semi-steel should be melted hotter than is ordinarily the case. A mixing ladle at the spout always should be used to obtain uniform metal.

Q & A

Acid-Proof Castings

QUESTION

At present we are experiencing difficulty in producing an acid-resisting cast iron for digester blow-pipes for pulp mills. These pieces weigh 1900 pounds and run from 1 inch to 3 inches thick. We tried a semisteel mixture containing 50 per cent steel scrap and 50 per cent cast iron scrap and it lasted four months. Later we used the same mixture with the addition of 2 per cent nickel shot with the same result. It is obvious that the iron was white and could not be machined. Do you know of an acid-resisting mixture that can be machined freely so that the flanges of this pipe could be faced to make a perfect joint?

ANSWER

The best acid-resisting cast iron contains from 13 to 14 per cent silicon, is a difficult material to handle, and must be made in the air furnace or electric furnace. Alloy cast irons containing chromium have acid resisting powers, but like the high silicon, cannot be machined if the chromium content is over 1 per cent. If nickel is added in combination with chromium to a ratio of approximately 2 or 3 nickel to 1 chromium, a better structure is said to result, and machining possibilities are increased.

You state that you used a 50-50 steel and iron mixture that gave a white iron. It appears to us that you should be able to obtain a mottled or gray structure with a mixture of that type. Since you do not state the kind of scrap iron you are using, we presume that it is low silicon iron, probably white iron to begin

with. By a better choice of scrap iron containing higher silicon you should obtain a gray or mottled structure.

You will have difficulty in obtaining a cast iron that has a structure to withstand acid corrosion and be machinable as pointed out previously. The thing to do is to steer a middle course. Gradually increase the silicon content of your iron until you obtain a mottled structure. A structure of this type will be midway between gray iron and white, and will have characteristics of both. It can be machined and will be acid resisting to a certain extent. Some experimental work will be necessary to determine the best mixture for your purpose.

Q & A

Desires Chilled Iron

QUESTION

Can you give me the analysis of high grade chilled iron including the total carbon, silicon, manganese, etc.?

ANSWER

Chilled castings have the following range of analysis: Silicon, 0.75 to 1.25 per cent; sulphur, 0.08 to 0.12 per cent; phosphorus, 0.20 to 0.40 per cent, manganese, 0.80 to 1.20 per cent, and a total carbon, under 3.50 per cent. The carbon may range lower than this if steel scrap is used in the mixture although the tendency for low silicon irons is to run higher in total carbon.

Q & A

Pistons Are Spongy

QUESTION

We are sending to you a piece of a large piston which is 22 inches in diameter and 11 inches high. So far we have cast eight of these without obtaining a good one. We used 30 per cent pig iron containing 1.75 per cent silicon; 20 per cent steel scrap, gray iron scrap, 50 per cent, and 3 per cent nickel. We also tried charcoal pig iron containing 1 per cent silicon, and added 2 per cent nickel. Every one of the castings had a spongy place at the bottom of the ring groove.

ANSWER

The sample that you sent was quite rusty and therefore rather difficult to examine. You did not give any details as to how the casting was molded. However, it appears to us that the cause of the spongy section is due to a boiling in the core. We do not know what kind of core you used, but assume it to be green sand. The sand may have been rammed too hard at this point or may have been wet. This would cause a slight boiling action with the resulting spongy section in the piston casting.

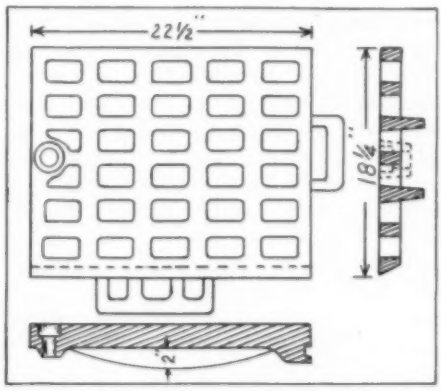
The iron at the clean fracture appears to be uniform, clean and has a good structure, so it does not look as though the iron is at fault. However, you might send some drillings to a reputable analytical laboratory and have the analysis determined to give you an idea of its composition.

GENERAL

Stops Small Blowholes

QUESTION

We are enclosing a blueprint of a manhole grate which we have made for several years without any trouble. Recently the castings show blowholes when the gates are knocked off. The metal is poured into the mold through four branches as shown in the lower sectional view. The holes are not on the top but near the bottom at the point where the gate joins the side of the casting. These holes are small, sometimes no larger than a piece of wire and not over ½-inch deep. Occasionally they are larger on the inside. The castings are poured from a good grade of iron approximately 25 per cent pig and the remainder machinery scrap.



TWO-PRONG GATE SHOWN AT END IS PREFERABLE

ANSWER

Something about the sand is causing the metal to boil in the vicinity of the gates and when this cause is discovered and removed you will have no further trouble. The molder may be using a closer sand, ramming it a little harder than formerly or he may be using the swab too generously. A possibility exists that you are using shallower flasks than usual, or that the bottom boards are without cracks and are clamped too tightly. It may be that the molder is omitting to vent the drag, particularly that section between the ribs on the pattern. Any, or all of these things will cause a commotion in the mold when it is filled with molten iron. Your method of .gating the mold, while not responsible for the blowholes, still is reprehensible from a technical and economic viewpoint. The inlet gates should be located opposite the bars in the cover and not as you have shown them in the blueprint, opposite the sand cores between the bars. They should be located at the end and not at the side and finally there should be only two branches instead of four. These branches should lead the iron directly to the two long ribs in the bottom of the mold so that they may fill first. Another advantage of this gate is that the amount of iron required to fill it is reduced.

Q & A

Limestone Cleans Cupola

QUESTION

Recently I have taken charge of a foundry in which the average daily heat is 23,000 pounds made up of approximately 10 per cent outside machinery scrap, 20 per cent return scrap and the remainder the best grade of pig iron. Former custom favored the use of 300 pounds of limestone. In former experience I had charge of a cupola for several years in which many thousand pounds of iron were melted daily without the use of a pound of limestone. What do you think of the use of limestone in a gray iron mixture?

ANSWER

Whether or not limestone should be added to the cupola charge depends on local melting conditions, particularly the length of time the cupola is in blast and the character of the fuel and iron. For example in your case a 23,000 pound heat could be melted easily in a 60-inch cupola without a pound of limestone. The same heat would choke a 28-inch cupola in an hour if attempted without limestone. The effect on cupolas of a size in between would be proportionate to the diameter. For example the cupola man would have considerable picking to do in a 48-inch cupola in which a 23,000-pound heat was melted without limestone. The same cupola if properly fluxed would drop perfectly clean. To a certain extent the question of using limestone on fairly short heats depends on whether it is cheaper to buy limestone or pay for the extra time required to pick out and daub a dirty cupola. In long heats of course the use of limestone, or other flux, is obligatory. If a fluxing agent is not employed a bridge will form above the tuyeres and effectually prevent any further melting.

In ordinary practice a certain amount of sand and scale accompanies the iron into the cupola. All coke contains ash, some species in greater proportion than others. The sand and ash melt with the iron, but on account of the difference in specific

gravity they float on top in the form known as slag. If this slag is allowed to remain in the cupola it freezes quickly and prevents the passage of the blast upward to the melting zone. Without entering into the chemical reaction which takes place, it is sufficient for practical purposes to know that lime unites readily with this slag and produces the same effect as when turpentine is added to paint. It renders it thin and fluid in which condition it flows readily through a slag hole provided in the back of the cupola for that purpose.

Q & A

Composition of Seacoal

QUESTION

What should be the analysis of a good seacoal for facing molds for automobile castings?

ANSWER

The best type of bituminous coal, commonly known as gas coal, is used for seacoal facing. A coal of this type will contain 10 per cent or less ash, and the volatile matter will be at least 35 per cent. The main consideration is to have low ash and high volatile matter content in the seacoal used for facing.

Q & A

Causes Shell on Wheel

QUESTION

One of our molding jobs is a balance wheel 4 feet in diameter which one man has been running steadily for a year without any trouble. Recently, this casting has been coming shelly on the rim. I have tried different systems of gating, on the hub and on the rim, but without result. The casting weighs about 450 pounds. Can you suggest a cause for the trouble and a method for preventing it?

ANSWER

Any one of several causes may be responsible for the shelly edge on the balance wheel casting. For example the man who has been making the wheel for a year may have been replaced by another man who is not familiar with some of its peculiarities. In that case a little education will be required. He will have to be shown. In the event that the man who has been making the wheels for a year successfully, now begins to turn out defective castings, then clearly the problem assumes a different aspect and a close supervision of the job may be required to discover the obscure cause of the trouble.

The shelly edge is caused by steam or gas that is held in the mold while the iron is solidifying. If you can prevent the formation of this steam, or if you can provide a means for it to escape through some passage other than into the mold, your problem will be solved. All green sand molds generate steam when molten iron is introduced into them. Where the sand is sufficiently porous, and where the volume of steam generated is not too great to escape through the natural passages, no trouble will be experienced. However, and unfortunately, favorable conditions do not always obtain. Steam works into the mold cavity, remains there until the iron has solidified and results in cavities known as shells, blisters or blowholes at or near the surface.

Shelly areas or blowholes in small or large numbers indicate that the metal was bubbling while it was rising in the mold. Bubbling may be due to hard sand, tight sand or wet sand. Sometimes the margin between success and failure depending on the hardness, tightness and wetness of the sand is exceedingly slight. For example a new, tight fitting bottom board will cause iron to boil in a mold where it never boiled while an old loose fitting board with many cracks was employed. Some sands may be rammed quite hard and still remain sufficiently porous to permit the escape of all steam. Another grade of sand rammed to the same density will not permit the steam to escape readily and some of it will pass through the metal. This feature is so well known that makers of molding machines recommend different operating conditions for identical machines on identical molds, but situated in different localities where the character of the sand varies.

Style of gating practically is immaterial on a balance wheel casting so far as the utility of the casting is concerned. It may be gated on the hub, the rim or between the arms.

Q & A

Small Vents Cause Shell

QUESTION

I shall appreciate any information you can give me on the cause of thin scabs or shells in the corners of ingot mold castings. The trouble is not constant but appears periodically at irregular intervals. Our practice apparently does not change either in making the molds or in the quality of the sand employed and yet the castings are not always the same.

ANSWER

Since your castings are perfect in the majority of cases it is only reasonable to infer that your practice and equipment are suitable. This condition reduces the probable cause of the trouble down to one of three factors: Wet sand, hard sand or plugged vent holes in the core barrel.

Of the three we are inclined on general principles to the belief that the condition of the core barrel is responsible. In the course of time the vent holes in the barrels gradually become closed from the constant application of claywash or paste that precedes the sand. The holes in the corners of the barrel are the most important and yet they rarely receive the consideration their importance warrants.

In a great many cases the cores forming these holes become displaced during the pouring of the core barrel casting and no attempt is made to reproduce the holes by drilling. As a consequence, the corners of the barrels which really require the most venting on account of the iron which surrounds them on two sides, sometimes receive the least. In cases where through ignorance or carelessness the corner holes have not been placed in the barrel, the foundryman usually finds it necessary to place a long rod upright at each corner while the sand in the corebox is being rammed against the barrel. The rods are withdrawn before the box is removed and the holes they leave serve as passages for the gas while the ingot mold later is being filled with iron.

MALLEABLE

Carbon Form Changes

QUESTION

What are the principal reactions or changes that occur during the annealing of hard iron as used in the malleable cast iron industry?

ANSWER

The essential reaction is the conversion of carbon existing as cementite into the form of nodules of that element. This often is written as $Fe_3C = 3Fe + C$ (reversible reaction), but in reality occurs in a series of steps.

The cementite dissolves and forms a solid solution; the carbon migrates from the surface of contact of cementite and solid solution and at some stage the chemical forces holding the elements together in Fe_3C are broken. Free carbon then crystallizes out of solid solution.

There is also, at and near the surface, a removal of carbon due to the combination of oxygen of the air or packing with the carbon of the metal to form a mixture of carbon monoxide and carbon dioxide whose composition depends upon the existing temperature and pressure. The iron remains in the free state or in extreme cases is oxidized to FeO or further. These oxidizing reactions are, in modern practice, kept at a minimum.

Problems in Nonferrous Founding

By Charles Vickers

Flux Is Needed

We are making bushings 10 *inches long with* 1½ *inches of metal around the core and we experience difficulty with the mixture, which contains* 75 *per cent copper and* 25 *per cent lead. This alloy is specified and we cannot change it. The castings when machined are porous, and it is this condition we desire to overcome. We use electrolytic copper and the best grade of lead, and we melt with coke. We first melt the copper under charcoal in a coke-fired furnace, then, when it is so hot it will not stick to an iron bar, we hold the lead over the pot and allow it to melt off and drip into the copper. Then we stir, allow ten minutes to superheat, after which we pull the pot, skim off, stir well and pour at* 1850 *degrees Fahr. In many cases the metal begins to boil after being skimmed off. We mold the bushings upright, and gate on the bottom and have a big riser on top and after all this trouble they have a plentiful supply of gas holes on the outside when turned off. We have tried additions of phosphor-copper without improvement.*

This is quite an odd mixture. It is not an alloy, as copper and lead do not alloy in that proportion. Lead will hold a small amount of copper, and copper will carry a small amount of lead in solution. The idea of dripping the lead into the molten copper must be rather irksome, especially in summer. We are unable to see the good it does. It is a good way to aerate the melt, which is not desired. We suggest the lead be cut up into three or four pieces, each piece to be added to the molten copper by a pair of tongs so it can be pushed down under the surface. Then follow by stirring, next add more lead, and so on.

However, such a method will not prevent porosity although it may lessen the chance of porosity. What is required is a flux, and while there are any number of these, about the best that can be used with the mixture mentioned is common plaster of paris mixed with about 10 per cent borax. Use 2 per cent of this admixture, adding 1 per cent to the cold charge, and 1 per cent after the copper has melted but before it becomes hot. This will correct the porous condition.

Q & A

Pouring Yellow Brass

We are making yellow brass castings of the following composition: 70 *per cent copper;* 30 *per cent zinc, and add* 3 *ounces of* 15 *per cent silicon-copper as a flux. We get a pitted and drossy surface and the castings have a high shrinkage. We are using the silicon-copper in place of aluminum and we would like to get your opinion in regard to this practice. Should we use lead with silicon? Can you give us a better alloy than the above? The molds are made of Windsor Locks sand and are skin dried, and the metal is melted in an oil-fired crucible furnace.*

Neither silicon-copper nor aluminum is needed in 70/30 brass to make it flow, as this mixture is within the limits of castability; up to 30 per cent zinc. Sometimes these limits are exceeded by one or two per cent, and no metallic flux is added. However, if the mixture contains no lead, the results ought to be better than stated. Therefore, we are inclined to think the zinc carries a considerable content of lead as this element should be conspicuous by its absence when silicon is used. In fact, silicon refractories and lead usually disagree and make trouble for the founder. Keep lead away from any metal containing silicon. Silicon can be used to deoxidize copper for casting purposes, but no metallurgist worth the name would suggest its addition to leaded alloys, either of yellow brass, red brass or bronze.

Why not make a real yellow brass and learn how to cast it. Have well vented molds, and pour fast enough to keep sprues full of metal. They may overflow to the floor, but the spillings can be gathered up when cold.

In the furnace the brass must be *hot*. When an iron bar is held in the metal it must impart a vibration to the hands holding the same. Avoid the smoke when pouring by tying a handkerchief around the nose and mouth or wear a respirator. Use 70 per cent copper; 26 per cent zinc; 2 per cent lead, and 2 per cent tin, no aluminum and no silicon. However, use one ounce of 15 per cent phosphor-copper per hundred pounds of brass.

Q & A

Machining Is Difficult

We are making castings of government bronze 88-10-2 *which must withstand* 1000 *pounds water pressure. However, the customer objects to the castings being too hard for machining. Could you suggest a softer metal that will stand* 1000 *pounds water pressure?*

A softer alloy that is extensively used for high pressures is the following: 82 per cent copper; 4.75 per cent zinc; 7.50 per cent tin, and 5.75 per cent lead. Owing to the amount of lead it contains it will machine more easily than government bronze. A second choice contains 85½ per cent copper; 7 per cent tin; 4 per cent zinc, and 3½ per cent lead. The customer wants a high grade alloy and it has to be to withstand 1000 pounds per square inch water pressure.

Possibly because he does not know how to grind his tools properly, he feels he has a complaint to make because the metal does not machine easily. This is hardly consistent, but it is something the brass founder often has to contend with. If he was given an alloy that will cut like *cheese*, undoubtedly the castings would all leak like a sieve. Should neither of the above formulas give a soft enough alloy, persuade the man to experiment with an alloy of 82 per cent copper; 8 per cent lead; 8 per cent zinc, and 2 per cent tin. This will cut easily, thus fulfilling that requirement for it is about the softest brass that can be made, but it has no pretensions to being a pressure resisting alloy. Therefore it would be wise to insist that all good castings be accepted and paid for, the customer taking the risk in regard to the pressure resisting feature.

High Grade Cast Iron *Produced by* Large Steel Scrap Additions

By R. S. MacPherran

THE method of operation in producing high test cast iron is simple. A 54-inch cupola with one row of tuyeres, six in number, and a blast pressure of 8 ounces is used. These tuyeres are 3½ x 26 inches in size and are 19 inches above the sand bottom. The bed contains 2300 pounds of coke. After charging the cupola it is allowed to stand about one hour before the blast is put on.

Metal charges are 3000 pounds in weight, with 375 to 400 pounds of coke between charges. The metal charge consists of about 95 per cent steel scrap with 4½ per cent ferrosilicon and 0.5 per cent ferromanganese. The ferrosilicon contains 50 per cent silicon. About 15 per cent of a low-grade ferrosilicon containing 15 per cent silicon with about 85 per cent steel has been used. This works well, but does not give quite as low carbon as the higher grade silicon with the greater per cent of steel in the mixture.

The steel scrap is about one-half to two-thirds railway car springs and the remainder is steel rails. We have been advised to make short taps, as this tends to keep the carbon down. A standard arbitration test bar is poured from each ladle. From the lower half of this test bar a 0.505-inch diameter tensile bar with threaded ends is cut.

A list of 63 test bars, with their tensile tests and chemical analysis has been compiled. These have not been selected and are in no way experimental, but have been taken consecutively from heats run in October, 1928, good, bad and indifferent. Each ladle represents not less than 2000 pounds or over 17,000 pounds of metal. Of these 63 bars we found: Five breaking between 47,900 to 50,000 pounds per square inch tensile strength; 37 breaking between 50,000 to 60,000 pounds per square inch tensile strength; 19 breaking between 60,000 to 70,000 pounds per square inch tensile strength, and 2 breaking over 70,000 pounds per square inch tensile strength. The general average is 58,300 pounds. None of these bars was heat treated in any way.

One per cent nickel generally is used, either melted in the cupola or added to the ladle. When added to the ladle the nickel invariably is preheated to a dull red. In the spout about 6 pounds per ton of a ferro-

Gives Own Practice

MANY foundrymen are interested in the practical aspects of producing a high grade cast iron to meet certain specific demands which cannot be met by the regular types of gray iron that they produce. In this article which is abstracted from a paper presented during the annual convention of the American Foundrymen's association held at Chicago, the author describes the methods used in the foundry of his firm to produce a high grade cast iron, and the results obtained on test bars taken from regular runs of this iron. Mr. MacPherran is chief chemist for the Allis-Chalmers Mfg. Co., Milwaukee.

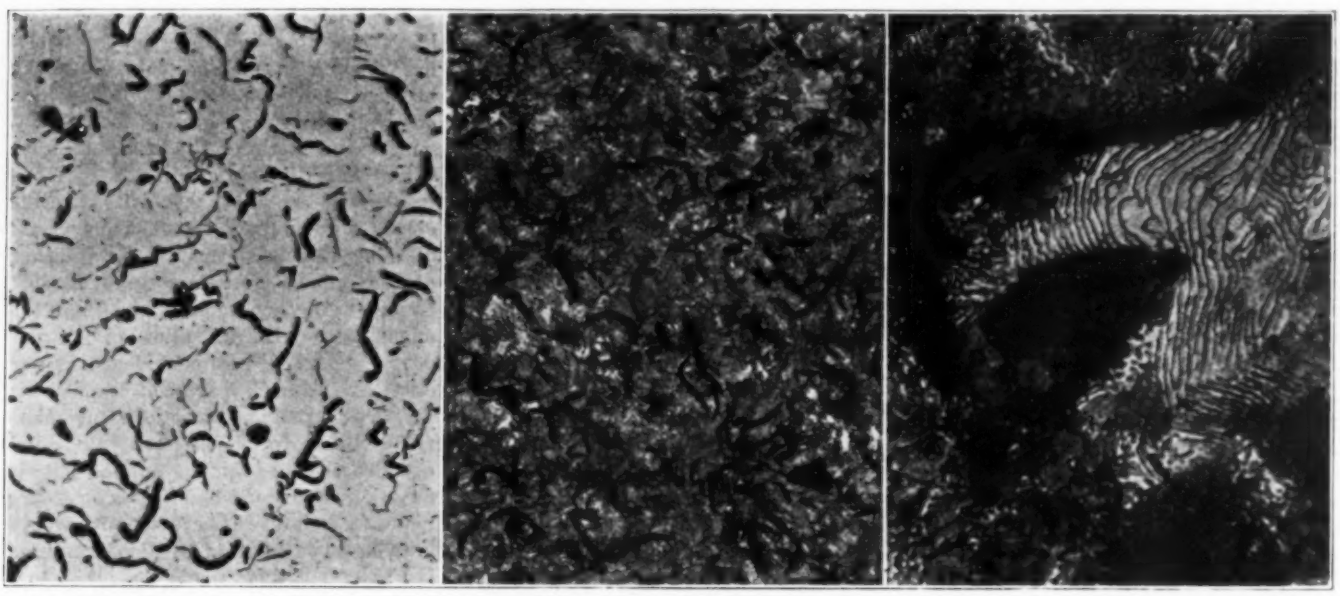


FIG. 1—STRUCTURE OF CAST IRON SPECIMEN UNETCHED AT 100 DIAMETERS. FIG. 2—SAME AS IN FIG. 1, ETCHED. FIG. 3—STRUCTURE SHOWN AT 1000 DIAMETERS, ETCHED

manganese-silicon containing about 50 per cent silicon and 25 per cent manganese usually is added. However, wherever possible the preference is to melt iron and alloys in the cupola and not in the ladle. It is realized that in theory it is better to add ferrosilicon, etc., to the ladle. Although this may give a higher strength in the bar we believe it has the danger of cooling the iron too greatly and therefore, maintain our present practice.

When making the first heats of this material it rather was expected that the metal containing so much steel would come out cold. The exact contrary is the result. The iron is hotter than any iron we have ever made.

Higher carbon irons usually come from a small ladle run first from the cupola. The secret of high test iron seems to be low carbon and high temperature of melting. The silicon has been varied from 1.50 to 3.00 per cent without materially affecting the strength of the test bar. The practice mentioned is not claimed to be the ideal practice, but is producing castings of high strength commercially.

It is quite possible that if the amount of metal melted could be standardized, the coke reduced and 5 to 6 tons of metal to be tapped first more consistent results would be obtained. Lower carbon in small heats could be obtained by using a smaller cupola.

Releases Information on Gray Iron Industry

The department of commerce recently has published a booklet containing the results of a survey of gray iron foundries in the United States. A statistical analysis of the operation and production of 646 gray iron foundries, who co-operated with the government in supplying the necessary information, is contained in the publication. The survey was conducted by the department upon the request of the gray iron industry and was undertaken primarily to determine the relation between production and capacity.

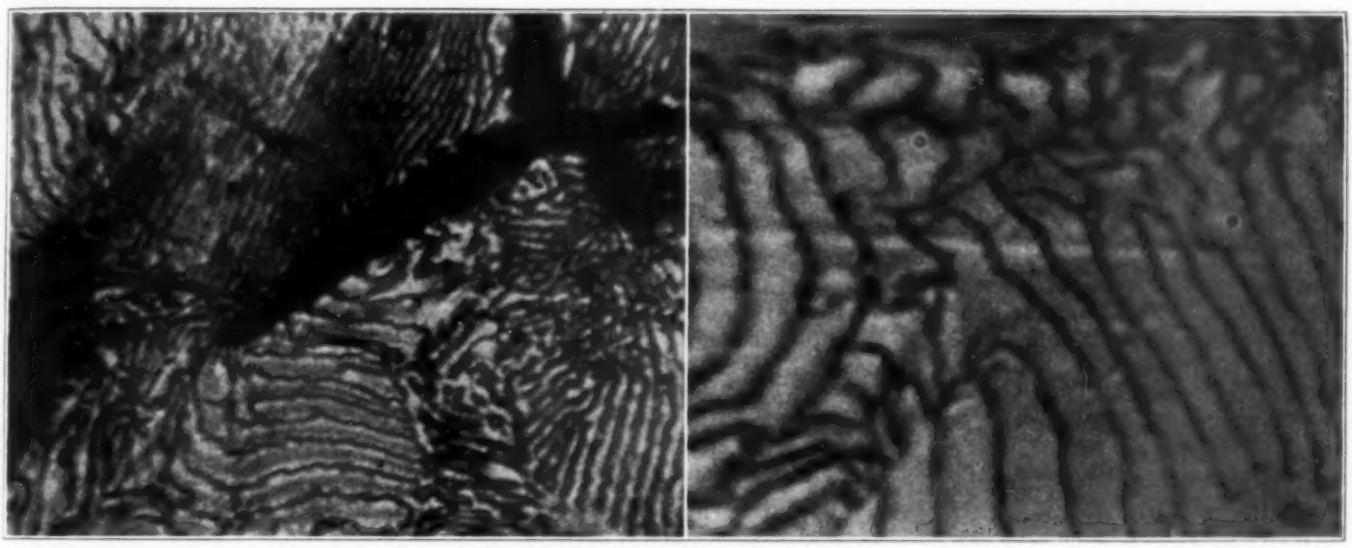


FIG. 4—SAME IRON AS IN FIG. 1 AT 3000 DIAMETERS, ETCHED. FIG. 5—STRUCTURE REVEALED UNDER A MAGNIFICATION OF 5000 DIAMETERS, ETCHED

It has, however, a short freezing range and should be handled quickly.

It also was expected that a large amount of liquid shrinkage, with considerable solid contraction would occur. While there may be a little more solid contraction than with a weaker iron no increase in the liquid shrinkage was found. However, the metal does need a rather better grade of sand, as the pouring temperature is usually quite high. It does well in dry sand molds. It is considerably harder than the usual run of cast iron and, in fact, machines about like a steel casting. To overcome any possible difference in fluidity gates and risers on the castings have been made a trifle larger than for ordinary iron.

The total carbon runs from 2.40 to 3.10 per cent, silicon from 1.60 to 2.60 per cent, manganese, preferably 0.70 to 0.90 per cent. The brinell hardness on the test bar runs from 240 to 290. The brinell on the casting will vary somewhat and will be lower on a large casting. In general, however, it will run about 225.

The variations referred to are due to at least three causes. First, low melting point of ferrosilicon, which sometimes runs ahead. Second, small size of some ladles (2000 pounds). Third, for special reasons some of the large castings purposely are made with silicon below 1.80 per cent.

Figs. 1 to 5 show a few micrographs taken of a test bar poured from a 4-ton ladle, which was the second taken from the cupola. This bar broke at 71,400 pounds per square inch with a brinell of 269. The analysis of this bar was: Total carbon, 2.81 per cent; silicon, 2.12 per cent; sulphur, 0.097 per cent; manganese, 0.94 per cent; nickel, 1.13 per cent; graphite, 2.01 per cent, and combined carbon, 0.80 per cent.

The bureau of mines has published bulletin No. 308 on "Oxides in Pig Iron: Their Origins and Action in the Steelmaking Process," by C. H. Herty and J. M. Gaines Jr. The price of this bulletin is 15 cents and may be obtained from the government printing office, Washington.

Much of the information secured from questionnaires is presented in the form of charts. The survey attempts to set forth the facts regarding gray iron production in the United States and to compare different groups of foundries, with a view of providing some basis for measuring the efficiency of foundries by geographical districts and size groups. Comparisons also are made between foundries which produce castings for further manufacture in their own plants, jobbing shops and foundries which do jobbing work and also make castings for their own use.

Foundrymen interested in checking the information shown in the survey with similar statistics in their own gray iron foundries may secure copies of the booklet from the superintendent of documents, Washington. The price is 15 cents.

H. D. Conkey & Co., Mendota, Ill., manufacturer of overhead traveling and crawler type cranes, is building an addition to its plant which will double its capacity.

Bill Offers Advice on Permanent Molds

By Pat Dwyer

AFTER the family had retired the other night, I sat before the fire for a final smoke in peace and comfort with no one to bother me asking questions or giving orders. The night was Christmas eve. The barrage of questions had been showered down by a certain young lady whose thirst for information ranged all the way from the year 1, A.D. to the present. The orders came from another lady, not quite so young, who holds decided views on the proper manner of erecting and trimming a Christmas tree.

From constant yearly repetition over a period of many years I was fairly letter perfect in the story of the *Three Wise Men* who followed a blazing star over the trackless desert until it came to rest over a lowly stable in the little village of Bethlehem in the hills of Judea.

The young lady could not understand why three kings chose to travel on the back of smelly old camels instead of driving in their own cars. Also she wondered why they should steer their course by a star. Did they not have an automobile map and were the routes not all marked on the telegraph posts? She was cautiously skeptical on the subject of Santa Claus. She could understand his traveling in an air ship, but how he kept a sleigh and a team of reindeer in the air while moving from place to place taxed her credulity to the breaking point. A critical examination of the fireplace and the chimney led her to doubt Santa Claus' ability to descend all in one piece. I am afraid that my ingenious explanation of the old saint's magical ability to expand and contract at will, failed to carry conviction. She pointed out, quite logically, that while Santa might inflate and deflate himself like a toy balloon, his huge bag of toys, certainly could not be manipulated in a similar manner.

I waged a hopelessly losing fight for an hour and then ignominiously surrendered. I told her the truth, the whole truth and then a little more. How little we know of what is going on in the little innocent minds! I found I had wasted a perfectly good hour and several hundred priceless words.

"I thought it was all a lot of hooey" she exclaimed inelegantly "ever since I peeked the other day and saw Maw hiding packages in her bedroom clothes closet!"

Out of the mouths of babes and all that sort of thing. Me for the straight and narrow path hereafter.

The tangy smell of spruce from the tree carried my mind back over a period of many years to the first Christmas tree we set up a couple of years after we were married. The tree had been an annual feature ever since. With each succeeding year the memories it calls up, tender, sentimental, joyous and sorrowful blend as so many strands into the shining cable by which the members of one family are bound together into one group.

For several years the Christmas tree has been secured by the simple expedient of telephoning to the corner groceryman. I don't know where he gets them any more than I know where he gets any of the other items he supplies. Why should I care? That's his lookout. Let him worry. All I need to know is that on the 24th of December a tree is deposited on the back porch. Why or by whom it is left are details of no importance. Perhaps Santa Claus leaves it. The only flaw in this theory is that an item for $2 or $3 for *one Chris tree*, inevitably appears on the December bill.

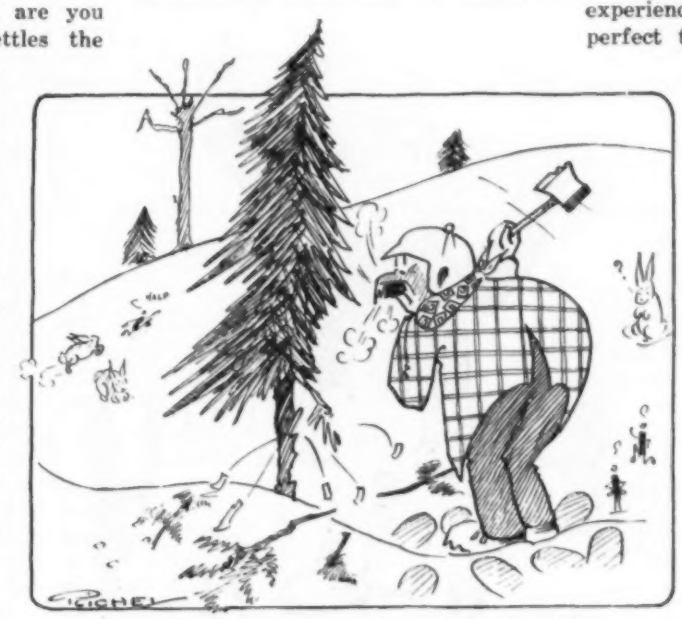
At the joyous yuletide season, the financial feature cheerfully, conveniently and thoroughly is forgotten, or, perhaps I should say, is ignored. The old stocking is dragged from its hiding place and emptied down to the last nickel coyly hiding in the extreme apex of the toe. The china teapot is taken down from the high shelf, dusted off and emptied of its hoarded accumulation. The toy bank is unscrewed or pried open. When, as occasionally happens, it refuses to disgorge at a speed and in amount to satisfy the suspicious owner, it is subjected to the hammer test. After this test the bank no longer can be classed as a going concern. It is gone! On a cold, practical basis of common sense and logic one should be justified in assuming that if he does not spend money, the aforesaid money should remain in his possession. For some mysterious reason, which up to the present I have been unable to figure out, this assumption does not work out in practice. For a period of 18 or 20 years I paid absolutely nothing for the annual Christmas tree, therefore in the present year of grace A. D. 1929 I should be able to show a cash balance ranging between $36 and $60. The calculation is based on (a) A minimum of

QUAINT OLD CHRISTMAS CUSTOM, BREAKING THE BANK

18 trees at $2 each and (b) A maximum of 20 trees at $3 each. Have I this money? In a clear, ringing, manly voice, realizing the full effect on my reputation as a citizen of standing in the community and the—er—titular head of a family, I answer "NO!"

If I am pressed still further—as I have been pressed on occasion—and asked to explain where this money went, or the more embarrassing request to explain why this money is not available on demand, I am reduced to the humiliating position of saying "I don't know" to the first question and "I have not the faintest idea" to the second.

The usual clincher "What are you going to do about it?" settles the argument temporarily, but the fruits of victory are singularly lacking in the vitamins and carbohydrates. More, if you take my meaning, they are on the order of the dead sea ashes from this here soggy and tomorrow place where Lot coined a famous slogan by calling his wife the salt of the earth. Modern commentators profess to see in this a sly allusion on Lot's part to the fact that he considered his wife too fresh. I do not say whether I hold or do not hold with this view. The point is raised as something of possible interest and as such respectfully is referred to the Amalgamated Association of Down Trodden Husbands, who individually and collectively occasionally are forced to take refuge in ambiguous statements.



TWO OF A KIND, FOLKS, AND BOTH LOPSIDED

At this point—in fact, perhaps before he has arrived at this point—a doubting reader of the younger generation, probably is saying, or has said to himself "If this here guy did not pay for 18 or 20 Christmas trees, how did he get 'em? Looks kinda fishy to me. O' course it may be all right, y'understand, but then again on the other hand, why did he switch from the free variety to the present trees for which he has to pay? Must be a nigger in the woodshed or a snake in the bush or sumpin."

Let this serve as a salutary warning against the nefarious practice of hastily jumping to conclusions. During this period to which I referred, I lived in a small town bordered on one side by the waters of a noble harbor and on the remaining three sides by the forest primeval.

Technically the trees belonged to the government and it is quite possible that ponderous and creaking governmental machinery would have been set in motion had I entered the woods with a logging crew and cleared away a few acres. If I was unfortunate enough in the choice of a lawyer, I might have been forced to pay a small fine. With a good lawyer, one who could show that the wide spreading woods were the property of all the people and not the private property of the corrupt party then in power—through accident—an accident, gentlemen, mark you to be rectified at the next election—I might have escaped with a mild reproof, or, at the worst, a formal order to cease and desist from cutting and removing any more trees from the public domain.

However, so far as the cutting and removal of one small spruce tree was concerned, no person, public official or private citizen, paid any attention. A few enterprising citizens earned an honest penny—later, I regret to say squandered for the Demon Rum—by cutting perhaps a dozen trees, hawking them around town and disposing of them to the more opulent inhabitants.

I was not opulent. I entertained conscientious scruples on the subject of a fellow citizen imbibing or guzzling such an overdose of firewater at one session. I fared forth to the forest and cut my own tree.

Before starting on the annual pilgrimage I was given a full set of directions and specifications. The tree must be so high and no higher, so wide and, mind you, no wider. The branches must be uniform in length all around and not too close together, but at the same time, not too far apart like the tail feathers of an ancient hen caught in the rain. I was exhorted to use a little taste and discretion and bring home something that resembled a Christmas tree in full bloom and not a misbegotten monstrosity like the inverted skeleton of a codfish or an umbrella that has blown away and then been run over by a 10-ton truck loaded with bricks.

Usually the snow on the main road was broken down, but in the woods it was at least knee deep. At a distance all the young trees look alike and the amateur rashly decides that all he has to do is to walk boldly up to the first tree and hack it down. Through bitter experience I discovered that only one perfect tree is to be found in each square mile.

So far as contact with his fellow beings is concerned a man might as well be on Robinson Crusoe's island as in the north woods in winter. With the goats and parrots on land and in the trees and the booming surf beating up against the rocks, Crusoe's island was a veritable boiler shop in contrast to the chilly and absolute silence under the trees. Occasionally the explorer comes across the tracks of a squirrel or rabbit, but the track makers are discreetly invisible. They may have had their eyes on me and probably nudged each other slyly at the vision of the strange animal floundering around in the snow. To be perfectly frank, I never have seen any of our humble four-footed friends nudging each other and exchanging witty remarks, but in the works of many eminent authors I have seen reference to these features.

Lacking any positive proof to the contrary I have accepted these stories at their face value. Occasionally a small doubt would assail me. As for example when the monkeys and snakes and things in the jungles of Brazil or the impenetrable fastnesses of the Malay peninsula, conversed in the purest English.

I brought this point up with Bill one time and he agreed it was positively amazing. He claimed to know hundreds of monkeys in this country who could not speak English even after going through the public schools.

All things finally come to an end. Eventually I discovered the one perfect tree and cut it down with a few shrewd blows of the trusty axe. Tired, cold and hungry and practically worn to a frazzle from the exhausting work of dragging the thing through the

woods and down the road, which in some mysterious manner had stretched out to 3 or 4 miles, I arrived with the tree at the old homestead.

The select committee of one viewed the masterpiece and coldly remarked that she might have known I would cut down and drag home the first tree I saw. She supposed it could be utilized, now that it was on the premises, but next Christmas she would have a man bring her one that bore at least a slight resemblance to a real Christmas tree. In her secret heart I think she believed that if I exercised proper diligence I could find a Christmas tree out in wild wood with a base attached to one end and a star of Bethlehem shining bravely on the other end.

Idly wondering what would have happened had I ever voiced this belief, I knocked the ashes out of my pipe and crept away to bed.

* * * * *

This point and many others, touching on Christmas past and present, came up Christmas day while Bill and I, gorged, lazy and happy, roosted in front of a cheerful fire. The other members of the family had scattered after the manner of the modern family which only uses a house as a place to sleep and take meals occasionally. We had the place to ourselves.

"Christmas ain't what she used to be," Bill lamented. "The old family spirit is gone. Every person is in too much of a hurry and too intent on his or her own private affairs to pay any attention to the others. Talking to a friend of mine the other day, the conversation turned on the young generation. Whither it is bound and so forth. He instanced his son as a case in point.

"The boy finished high school and then discussed with his father the possibility of attending college. The father supported the idea and told the boy if he worked for a season and saved his money, he would be glad to contribute enough to make up any deficit.

"Contrary to the father's wish, the boy decided he could earn and save the greatest amount of money by shipping for the season as a deck hand on one of the Lake boats. With commendable perseverance he stuck to the job for the entire season. He was smart and willing and was promoted early in the season from the deck to the engine room. Naturally, the father experienced a justifiable pride in his progress. The boy was bound to win out whether he followed his original intention of going to college, or of sticking to the marine field and climbing to the position of chief engineer of one of the big boats, or port engineer of one of the fleets which sail the Great Lakes.

"What do you suppose happened? The lad came ashore at the close of navigation with $300, three hundred iron men all his own. He blew in 75 bones for a Christmas present for his girl and spent the remainder for a second-hand automobile. He no longer had any desire to go to college and as for again going down to the sea in ships, he says them as likes 'em can have 'em. He's through. He got himself a job in one of the local factories.

STRIKE UP THE BAND! HERE COMES A SAILOR!

"The old-fashioned idea of commencing at the bottom and working into a permanent job appears to have gone into the discard.

"Talking about permanent things, did I ever tell you of an inquiry I had one time from a man who wanted to develop a permanent mold? He forwarded for my inspection a flat disk casting, 11 inches diameter, ¾-inch thick, with a double cam groove recessed in the face to a depth of ⅝-inch and an average width of ¾-inch. When the entire machine is assembled the groove serves for a race in which a shoe slides around, and therefore the groove must be exceedingly smooth. Up to that time he had been pouring the casting against a dry sand core, which is dropped into a plain print made in a drag on a molding machine. The cope is made in green sand. The core is made from a fine grade of sharp sand bonded with oil and the face is covered with a coating of blacking. The castings were not coming as smooth as he would like to see them and he was wondering if I could suggest a better way to make them. What did I think of the possibility of converting it into a die cast job?

"Basing my opinion on the appearance of the casting I should say he had selected the most satisfactory method of making this casting. A core made from fine sand, bonded with oil and covered with a nice coat of blacking should produce a practically perfect face on this comparatively light gray iron casting. Minor defects on the face of the casting submitted for examination seemed to indicate that the metal fluttered while flowing into the mold and in so doing, dislodged small bodies of sand. I pointed out that he easily could determine this point to his own satisfaction by pouring one of the molds without a cope. There he could watch the behavior of the iron as it covers the bottom and climbs over the core rings that form the races for the shoe. The core may be too hard, or too tight or not sufficiently dried, or it may be that the vent does not escape readily through the green sand in the drag. The bottom board may fit too tightly. A few holes with a vent wire and a few scratches in the sand immediately under the bottom board probably are all that are required. By attending to these seemingly trival details, I felt that he should have no further trouble in securing a reasonably smooth and accurate casting.

"By die casting I presumed he meant a method in which the metal is poured into metal molds. If he was prepared to spend a considerable sum of money and carry on experiments over a long period, it is quite probable that in time he might develop a permanent mold that would serve his purpose.

"The most difficult feature of the mold will be the development of satisfactory mechanism for stripping the part designed to form the groove. Roughly speaking and as a base on which to start experiments, I should start by mounting this part on the cope plate so that it may be withdrawn by a suitable screw arrangement immediately after the iron solidifies and before it commences to contract. If the change does not interfere with the efficacy of the casting, I suggested that the sides of the groove be tapered to facilitate the removal of the projecting part.

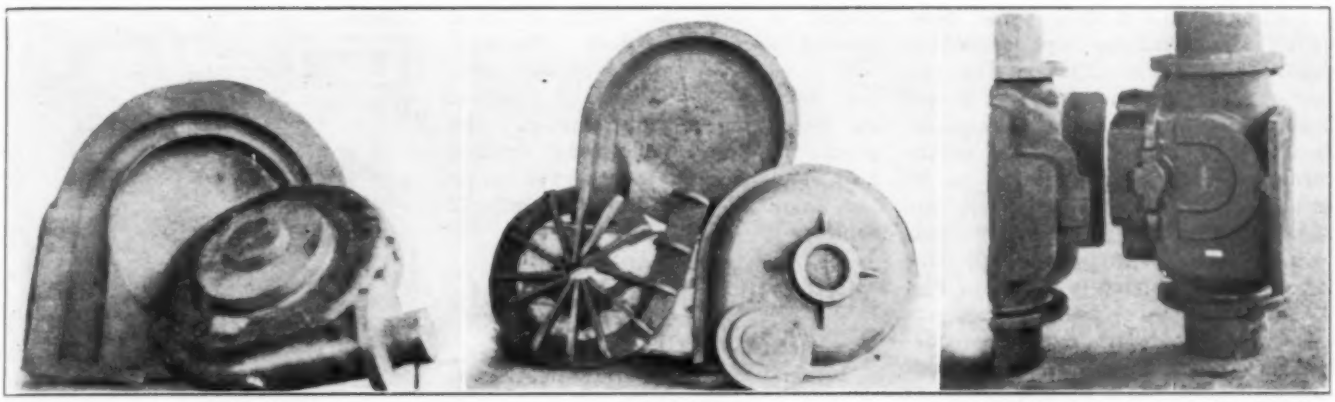


Fig. 1—Pattern and corebox for small pump casing. Fig. 2—Pattern for thin brass pump body. Fig. 3—Lower half pump body pattern ready for the foundry

Numerous Patterns Are Required *for Pump Castings*

By P. D. Forbes

PATTERNMAKERS and molders generally regard pumps as one of the most difficult and intricate classes of machinery they are called upon to produce. Outside and inside dimensions must be held to close specifications. In many instances only one casting is required and the cost of the pattern becomes an important factor. The methods and sometimes the materials vary to a considerable extent, depending on whether the pattern is to be used only once, or a great many times. Pump castings generally call for more or less intricate cores and these in turn require skilfully made coreboxes designed to eliminate subsequent rubbing of the cores to fit. Rubbing the cores to a fit takes up time and usually cores treated in this manner do not fit as accurately as properly made cores coming directly from the corebox. Pump specifications insist on close grain iron free from either surface or internal defects. Great care must be exercised in making the molds, melting and pouring the iron and in providing a clear passage for the core vents.

Pumps range in size from the little ones installed on automobiles to the giants found in modern water works. Fig. 1 shows the pattern and one-half corebox for a 3-inch centrifugal pump. This particular type of pump chamber is cast in one piece. The core is made in halves in two half coreboxes, one right and one left. The halves later are joined and placed in the mold where the completed core is supported by the print at the outer end and by the suction inlet core in the center.

A somewhat similar type of pump body is shown in Fig. 8. The pump casing is cast in two halves, right and left, and afterward bolted together. With a 20-inch impeller running at 720 revolutions per minute, this pump can deliver 1600 gallons of water per minute on a 50-foot head. A pump of this type usually is made to leave its own core. Each half of the pattern is built up in segments and the snail shape runner curve is carved by hand. A pattern for a brass pump casing with ½-inch thickness of metal is shown in Fig. 2. The skeleton shown in the illustration is placed inside the pattern for reinforcement during the ramming period to prevent distortion. The flange on the suction inlet is formed with a loose flange and coreprint either doweled to the main pattern, or, fitted thereon through a male and female joint. This part of the pattern is removed before the drag is rolled over and the opening is covered with a second ring core (not shown). In this manner the flange is formed between two dry sand cores and there is no danger of a *drop* from the small bodies of green sand between the brackets.

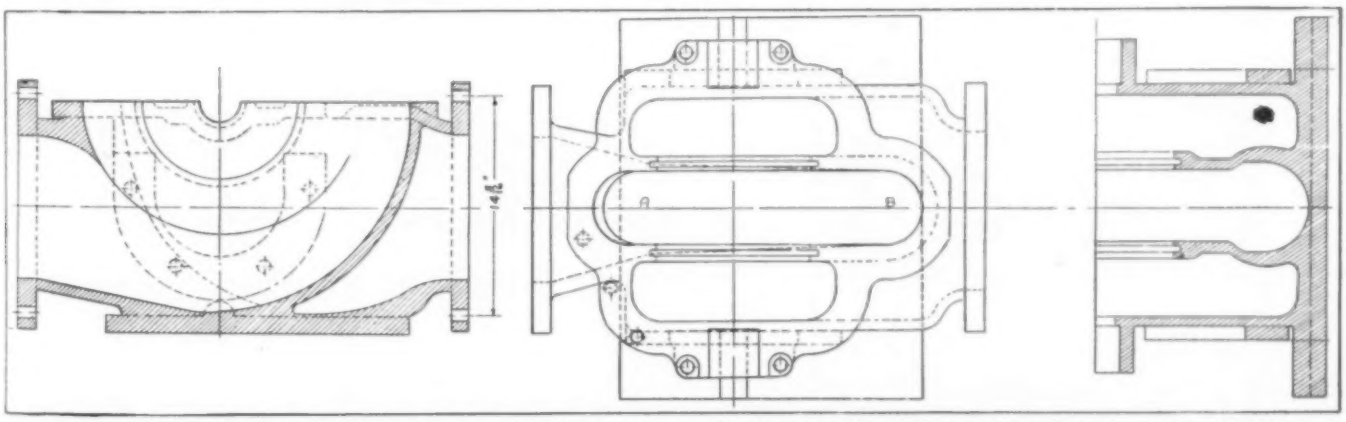


FIG. 4—LONGITUDINAL SECTION. FIG. 5—PLAN VIEW. FIG. 6—CROSS SECTION LOWER HALF TURBINE PUMP CASING

Figs. 4, 5 and 6 show three views of an 8-inch turbine type of centrifugal pump body. The pattern was parted along the line *A B* Fig. 5, and four main coreboxes were required, two right and two left. Two of the coreboxes with loose pieces to be inserted in corebox at the left are shown in Fig. 10. The complete pattern as it appeared before it was taken to the foundry is shown in Fig. 3. In this instance a first class pattern was required for the production of an indefinite number of castings. The finished pattern and set of coreboxes represents about 130 hours work of a highly skilled patternmaker.

Holds Cores in Place

Pattern and corebox for the cover for this pump casing are shown in Fig. 9. The pattern molded in the drag and the core suspended from the cope. Great care must be exercised in setting this core in the print and in pulling it up tight so that it will hang perfectly vertical and thus assure an even thickness of metal in the casting. A double strand of wire attached to each hook in the core passes through the cope and is twisted around a rod resting on two cope bars. Usually the wire may be twisted tightly with a pair of pliers, but in some instances the wire is twisted with the fingers and the necessary tightness is secured by driving a wedge or wedges under one or both ends of the rod.

An impeller for a sand pump, 6 feet in diameter and weighing 5000 pounds is shown in Fig. 7. Twelve of these castings were ordered and a rather ingenious method was adopted to minimize patternmaking expense.

The only pattern required was two sweeps and a corebox. One sweep was employed to form the profile *C* in the drag. The second sweep was employed to form the profile *D* on a cleared space on the floor. The corebox turned out six duplicate cores that formed the vanes and brackets on the inside of the casting. The profile *D* was rammed and finished hard and smooth and served as a face against which to ram all 12 copes.

Malleable Institute Holds Meeting

Action was taken to enlarge the activities of the Malleable Iron Research institute, at the regular annual meeting held at Cleveland, Dec. 11. Laboratory and metallurgical research work, which previously has been on a basis of improving the quality of product and efficiency of plant operation, will be enlarged and will be supplemented with branches in shop practice and inspection service. A program of market research also will be undertaken which will include studies in new uses and applications, specifications of materials for specific purposes and market conditions as affecting the uses of malleable castings The personnel of the institute will be increased by additional administrative, executive and field engineers to conduct the enlarged activities.

FIG. 9—PATTERN AND COREBOX FOR PUMP COVER

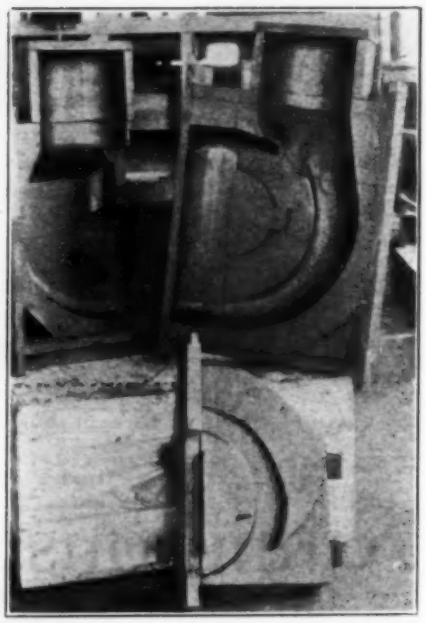


FIG. 10—RIGHT AND LEFT COREBOXES FOR PATTERN FIG. 4

The following men were elected to serve as officers if the institute during 1930: R. R. Fauntleroy, Moline Malleable Iron Co., Moline Ill., president; John G. Malnoski, Muncie Malleable Foundry Co., Muncie, Ind. and Joseph P. Kennedy, Baltimore, Md., vice presidents; Robert E. Belt, Union Trust building Cleveland, secretary-treasurer.

J. J. Hartley, formerly in charge of foundry equipment sales, western division Link-Belt Co., Milwaukee, has been appointed chief engineer of the company's Pershing road plant, Chicago. W. L. Hartley, formerly assistant in the foundry sales department, has been appointed manager of that department.

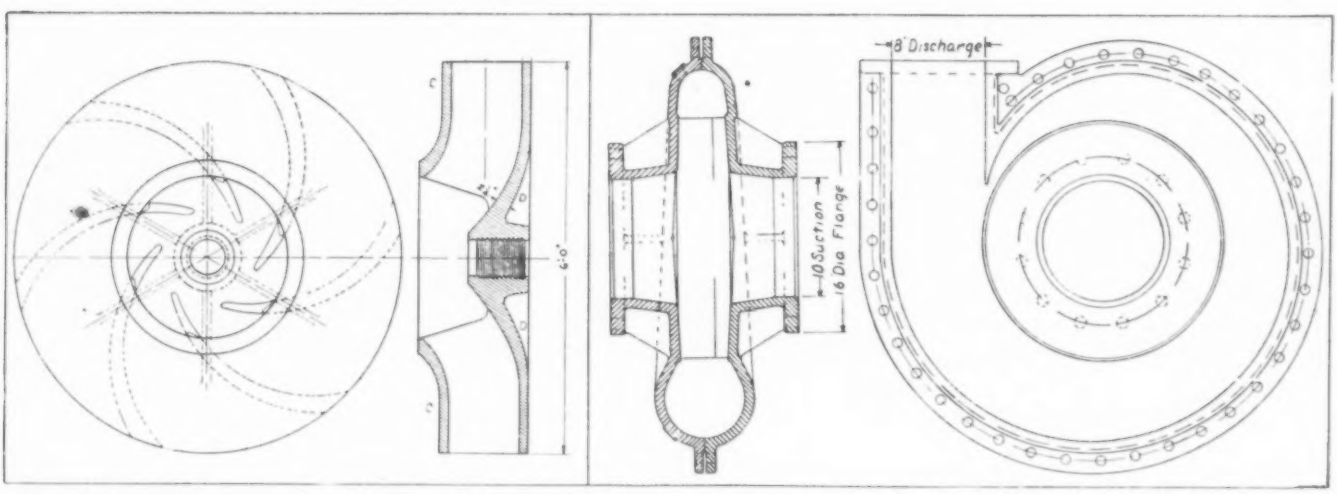


FIG. 7—PLAN AND SECTION OF 6-FOOT IMPELLER. FIG. 8—SECTION AND PLAN OF CENTRIFUGAL PUMP CASING MADE UP OF RIGHT AND LEFT PARTS

The FOUNDRY Family Photograph Album

Upper Left

JOHN DUFFY

Troy Sunshade Co., Troy, O.

Upper Right

J. A. DAVIES

Westinghouse Electric & Mfg. Co., Philadelphia

Lower Left

H. W. DIETERT

Detroit

Lower Right

C. G. GIBBS

National Malleable & Steel Castings Co., Cleveland

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

TENTATIVE STANDARD FOR GRAY IRON

FOR VALVES, FLANGES AND PIPE FITTINGS

(Concluded from Data Sheet No. 794)

7. Tension test specimens, cast as illustrated in Fig. 1, shall conform to the dimensions shown in Fig. 2, shall be reasonably smooth and round at breaking section and shall be tested without machining except that the enlarged ends shall be threaded (1¾-inch U. S. standard threads are recommended). The cross-sectional area at the breaking section shall be within 5 per cent of 1 square inch and the ultimate stress shall be calculated on the minimum cross-section.

8. Ball and socket specimen holders or spherical-seated bearings or

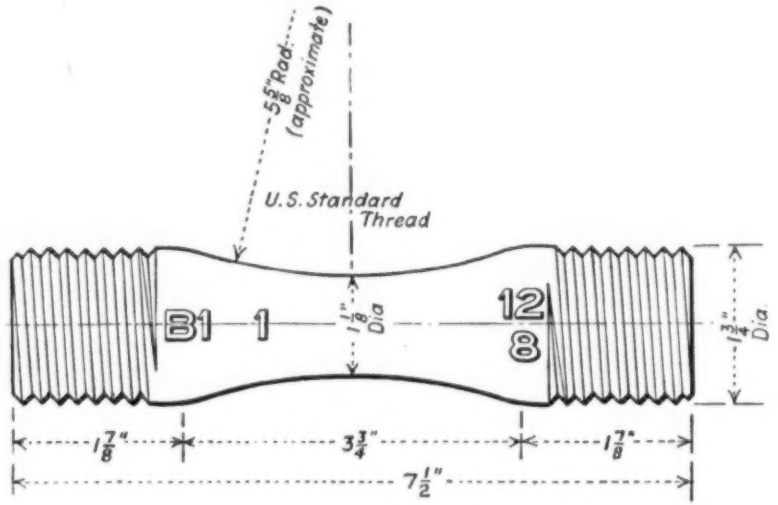


FIG. 2.—Tension Test Specimen.

other device which will insure that the specimen, when under load, will be as nearly as possible in pure axial tension without transverse stress shall be used in making the tension test.

9. Records of the chemical composition of the iron and physical properties of the test specimens shall be made and maintained systematically.

10. The castings shall be sound, clean, free from sand, of workmanlike finish and soft enough to machine well.

11. Upon request of the purchaser, the manufacturer shall be prepared to certify that his product conforms to the requirements of these specifications.

HINTS FOR THE CORE ROOM

(Continued from Data Sheet No. 792)

Medium and heavy cores for gray iron castings.
80 parts clean open silica sand.
1 part good grade core oil.
1½ parts corn flour.

Heavy cores using old sand.
40 parts clean open silica sand.
40 parts old sand.
1 part pitch core compound.
1 part corn flour.

Small and medium cores for malleable castings.
90 parts clean open silica sand.
2 parts good grade core oil.
3 parts corn flour. (More corn flour can be added where strong green strength is necessary.)

Miscellaneous cores for malleable castings.
45 parts clean open silica sand.
15 parts ordinary bank sand.
3 parts powdered rosin.
1½ parts corn flour.

Cores for aluminum castings.
10 parts clean new silica sand.
10 parts new molding sand.
30 parts foundry sweepings.
1 part corn flour.

Cores for aluminum castings.
80 parts clean open silica sand.
1 part linseed oil.
2 parts corn flour.

Stock cores.
90 parts clean open silica sand.
1 part good grade core oil.
3 to 4 parts corn flour.

Cores for brass castings.
80 parts open clean silica sand.
1 part good grade core oil.
2 parts corn flour.

Cores for light steel castings.
100 parts open clean silica sand.
1 part good grade core oil.
4 parts corn flour.

Large cores for heavy steel castings.
50 parts open clean silica sand.
50 parts old sand.
1 to 1½ parts pitch core compound.
4 parts corn flour.

(Continued on Data Sheet No. 797)

BRITISH FOUNDRYMEN *Cast* *Variety of Alloys*

Part V—Light Alloys

By Thomas H. Turner

Use Increases

INCREASING demand for reducing the weight of castings entering into the construction of automobiles and aircraft has led to the development of numerous light alloy castings with an aluminum base, and more recently, those with a magnesium base. In this article which is the fifth of a series giving data on alloys cast in Great Britain, the author describes the various aluminum and magnesium-rich alloys used in that country; giving their compositions, applications and physical properties.

PHENOMENAL development of road and air transport has caused an extraordinary expansion in the use of light alloy castings in Great Britain, as well as in all industrial countries. Copper or zinc-aluminum alloys are used for the bulk of the work. A copper, nickel and magnesium-aluminum alloy is the standard high duty alloy, and the still lighter silicon-aluminum alloys are popular where resistance to corrosion by sea water is especially important. Magnesium-rich alloys recently have been introduced, and promise to find extensive use.

Results of extensive researches into the properties of aluminum alloys were made generally available to industry when the British air board specifications were published by the British Engineering Standards association in 1921. These casting alloys have since that date been standardized almost throughout the whole industry, and the best of them (known generally as Y-alloy, from its original designation during investigations at the National Physical laboratory, near London, which determined its unique properties) recently has gained greatly in popularity. This alloy contains about 4 per cent copper; 2.0 per cent nickel; 1.5 per cent magnesium and the remainder aluminum.

Withstands High Temperatures

Y-alloy, or L24 as it now is called, is used for castings which have to withstand stresses at elevated temperatures, such as internal combustion engine pistons, but it also is used for many other highly stressed parts and possesses an excellent resistance to corrosion. It is heat teated usually at 510 degrees Cent. for 6 to 12 hours, and then aged rapidly by boiling in water for an hour or two. It was used extensively in the construction of the British monoplane which made a non-stop flight from England to India in 50 hours several months ago, and it forms essential components in many famous aero engines.

Practically without exception all the aluminum-rich alloys are cast to the well known air board specifications; their analyses and physical and mechanical properties conforming essentially to these specifications. For general castings for automobile work, such as sumps, gearboxes, etc., the air boards 2L5 and 3L11 usually are specified. Chemical compositions of these alloys are given in Table XXXIII.

These are the cheaper aluminum alloys, and since they are similar in mechanical properties, the choice often depends upon foundry considerations in their casting and other properties. Pistons, and other components which are subjected to heat, are specified in air boards 2L8 and L24, the former being cheaper and the latter superior in properties. The newer modified silicon-aluminum and the magnesium-rich alloys are not cast by many foundries; their use at the present time being mainly confined to special purposes. Moreover, these alloys are covered by royalty duties.

Substitution of mild-steel, sheet-stampings for certain of the more simple castings in aluminum alloys has occurred in many cases, but the replacement of these alloys as a whole is not to be expected. Die casting and similar processes whereby economies in machining are produced, are the chief trends of progress in the production of aluminum alloy castings. After visiting foundries on the Continent and in America, the author is of opinion that the casting of large articles in gravity-fed permanent metal molds has been developed more successfully in Great Britain than elsewhere. This process of permanent mold casting is widely used for gearboxes, crankcases and other relatively large articles required in large quantities. On the other hand, the various processes of pressure-fed die casting have been largely introduced from abroad, and are mainly employed in casting quite small articles like brake shoes, weighing machine and vacuum cleaner parts.

Use High-Silicon Alloys

Tables XXXIII and XXXIV refer to all the light casting alloys for which the British Engineering Standards association has so far issued specifications, but doubtless many other alloys are cast in smaller quantities for special purposes. Many of these other alloys are cast under proprietary names, but differ little in other respects from those just mentioned. One alloy deserves especial reference here, however, as it has been used more widely than some others for aeroplane and motorcar cylinder heads, and generally for castings where high internal pressure is encountered. This is a silicon-copper-aluminum alloy whose composition and physical properties are as follows: Copper, 8 per cent maximum; silicon, 2.5 per cent maximum; iron, 0.8 per cent maximum, and aluminum, remainder. The yield point is 22,400 pounds per square inch; tensile strength ranges from 26,880 to 31,360 pounds per square inch. The elongation on 2 inches is 2 to 3 per cent, and brinell hardness is 85 to 90.

High-silicon alloys of aluminum frequently are cast unmodified for pressure die-cast small parts of great accuracy. These alloys rapidly are in-

Table XXXIII

Chemical Compositions of Light Alloys

(Air Board Specifications, 1921, and B.E.S.A. Specifications, 1929)

Composition		L24 or "Y"	3L11	No. 361	2L8	No. 362	2L5	No. 363
Copper	Max.	4.5	8	8	13	13	3.0	3.0
	Min.	3.5	6	6	11	11	2.5	2.5
Zinc	Max.	0.10	0.10	0.10		0.1	14.5	14.5
	Min.						12.5	12.5
Nickel	Max.	2.3						
	Min.	1.8						
Magnesium	Max.	1.7						
	Min.	1.2						
Silicon	Max.	0.7	0.7	1.00		1.00	0.7	1.00
Iron	Max.	0.8	0.8	1.00		1.00	0.8	1.00
Lead	Max.	0.10	0.1				0.10	
Tin	Max.	0.10	1.0					
Total other metallic impurities	Max.			0.10		0.10		0.10
Aluminum		Remain.	Remain.	Remain.	Remain.	Remain.	Remain.	Remain.

creasing in popularity owing to their excellent foundry properties, superior resistance to corrosion and good mechanical characteristics. They are actually lighter than pure aluminum in some cases, and possess a better elongation than any other cast light alloy of aluminum now in use. They are modified by the addition of a small quantity (0.1 per cent) of metallic sodium or potassium, or by 3 to 4 per cent caustic potash or common soda. As mentioned, these alloys are restricted in use to certain licensees and are sold under proprietary names. They are being cast into many extremely complex and difficult shapes, such as the triple induction spiral of a well known British aero engine, and the complete thin section doors of London Underground railway carriages.

Silicon-aluminum alloys have been used in the modified condition to a considerable extent for castings handling fresh water or oil, and appear to be the only light casting alloys to find any favor with marine engineers.

In building the structure of R101, the new passenger and mail-carrying rigid airship erected at the Royal Airship works, many thousands of die castings in the 10 to 14 per cent silicon-aluminum alloy have been used. The mechanical properties of the chill cast 1-inch test pieces are: Minimum tensile strength, 26,880 pounds per square inch and a minimum elongation on 2 inches of 7 per cent. The castings are sound, remarkably ductile and accurate to size.

Production of alloys rich in magnesium on a commercial scale is relatively new in Great Britain, but it is an industry of great promise. Details of two such alloys are given. The first is used for motorcar crankcases, gear boxes and aeroplane engine sumps, and other such parts where lightness is a primary essential. Its specific gravity is only 1.84. This is a zinc-aluminum-magnesium alloy containing aluminum, 3.5 to 6.5 per cent; zinc, 2.5 to 3.0 per cent; manganese 0.25 to 0.75 per cent, and magnesium, remainder. The yield point ranges from 16,800 to 19,040 pounds per square inch; the tensile strength from 31,360 to 33,600 pounds per square inch; elongation on 2 inches is 7 per cent and the brinell hardness is 55.

The second is an aluminum-magnesium alloy and is used for general castings where hardness is required. Its specific gravity ranges from 1.86 to 1.89, and the composition and physical properties are: Aluminum, 10 per cent; manganese, 0.25 to 0.50 per cent, and magnesium, remainder. The yield point is 21,280 pounds per square inch; the tensile strength ranges from 24,640 to 29,120 pounds per square inch; elongation on 2 inches is 2 to 3 per cent, and brinell hardness, 65.

Table XXXV

Normal Range of Light Alloy Castings

Proprietary, or Standard Name	Tensile Strength Pounds/Sq. In.	Brinell Hardness	Elongation Per cent	Specific Gravity	Uses
Birmalite	35,840-42,560	130-150	0-0.5	2.9	Pistons.
Birmidium "Y"	24,640-28,000	90	1-2	2.79	Pistons, brake shoes and all high duty work.
Birmidium "Y", heat-treated	38,080-47,040	110	1.5-3		
Birmabright	20,160-22,400	53	5-8	2.66	Chemical engineering; shop fittings, ship fittings.
L8 (12 per cent copper)	20,160-24,640	75-80	1-1.5	2.93	Ordinary pistons; close grain castings.
L11 (7 per cent copper)	20,160-22,400	55	3-5	2.87	Die castings, where ductility is required.
L5 (2.75 percent copper, 13.5 per cent zinc)	24,640-29,120	65	3-6	2.97	Sand cast crankcases, etc.
Birmasil (13 per cent silicon)	26,880-31,360	56	7-12	2.68	Resistance to corrosion. Lighter than pure aluminum.

Table XXXIV

Physical Properties of Light Alloys

Properties	L24 or Y	3L11	No. 361	2L8	No. 362	2L5	No. 363	
Tensile strength Pounds per sq. in.	24,640	20,160	20,160	20,160	20,160	24,640	24,640	Specified minima.
Elongation per cent on 2 inches	nil	3	3	nil	nil	3	3	
Tensile strength Pounds per sq. in.	38,080-49,280							Heat Treated.
Elongation per cent on 2 inches	3-6							
Tensile strength Pounds per sq. in.	24,640-28,000	20,160-22,400		20,160-22,400		24,460-29,120		Average figures in practice.
Elongation per cent on 2 inches	1-2	3-5		1-1.5		3-6		
Brinell Hardness	90	55		77		65		
Specific Gravity	2.79	2.89		2.95		2.97		
Coefficient of expansion degrees Cent.	0.000022	0.0000246		0.0000264		0.0000255		
Contraction on casting per cent	1.29	1.19		1.25		1.27		

All of these alloys are poured, as a rule, from temperatures between 650 and 750 degrees Cent.

Addition of manganese to these alloys and their surface treatment, by dipping into a solution of dilute nitric acid and potassium bichromate, has done much to overcome their likelihood to corrosion in service. The author has seen these aluminum-magnesium alloys cast in Great Britain with apparent ease in commercial foundry work, and he has seen both small and intricate die castings and large and massive sand castings, which have been produced. The melting point of these magnesium rich alloys is in the neighborhood of 635 degrees Cent. Their pouring temperatures range from 680 degrees Cent. for thick, to 780 degrees Cent. for thin castings.

Table XXXV may be found of interest, in that it shows the grades of light alloy castings normally produced by one of the best of the foundries which the author has visited in the Midlands, and may be regarded as typical of good practice in Great Britain.

Before concluding this reference to the light alloys, mention should be made of two processes of British invention which are now practiced in the melting and casting of high quality aluminum alloys. The heat treatment of Y alloys, the modification of silicon alloys and the anodic oxidation for surface protection, have all contributed to the popularity of these alloys with the users. However, the foundryman is probably more indebted to S. L. Archbutt for his process, known as pre-solidification, by which it is possible to eliminate speckled metal and pinholes. A refinement of this process is to assist the elimination of the noxious hydrogen and other gases, by passing a stream of nitrogen through the melt during its cooling process. In foundry practice, this method results in better Y-alloy and silicon-aluminum castings. In the case of the copper-aluminum alloys, George Mortimer, whose papers have been of immense value to the whole industry, maintains that it is only necessary to treat the 50-50 hardener to a simple pre-solidification process, to produce economically a marked improvement in the final casting.

The second process to which one should refer is that in which light alloys are modified by an entirely new method, which involves the use of chlorine and chlorine compounds, particularly boron trichloride. Having been patented, this process is perhaps of less general application, but it is being employed in the production of castings known under a proprietary name, and in the refinement of secondary aluminum.

French Discuss Foundry Problems

NUMEROUS papers covering various phases of foundry practice were presented at the annual meeting of the Association Technique de Fonderie de Paris, held recently in Paris.

The opening session was presided over by M. Labbe, director of technical education at the Ministry of Public Instruction. In his opening address, M. Labbe laid particular stress on the necessity of scientific methods. He also emphasized the importance of the thorough training of future captains of industry.

The exchange paper of the Czecho-Slovakian association, prepared by E. Valenta, foundry engineer at the Skoda works at Plzen was read by M. Lemoine. The paper was entitled "The Production in the Electric Furnace of High-Resisting Gray Cast Iron". M. Lemoine, who opened the discussion, pointed out that the paper is more devoted to giving results that can be expected from the electric furnace than details of operation, and the paper is more for the engineers than the foundryman.

M. Ronceray asked M. Lemoine to speak of the influence of superheating in the electric furnace, and of the possibility of obtaining high-resisting cast iron in the cupola. M. Lemoine said that it now is recognized that high temperatures applied to cast iron in a liquid state have a large influence on the final state of the graphite for irons of a similar chemical composition. However, often this effect of superheating is not obtained when the charge in the electric furnace is made up of cast iron which already has a composition near to that which is desired. Experience has shown that if superheating is to have its complete effect, it is advisable that the iron charged in the electric furnace contain only the required percentage of carbon, and that the other elements, which should complete the final melt, should be added in the electric furnace in the proper order, silicon being added last when it is certain that the graphite is in a fine state.

M. Ronceray said that following certain experiments made by M. Roure, of the high school of foundry, to confirm investigations previously made in Germany on the superheating of cast iron, it was found that no refractories can resist the temperatures obtained in these experiments. M. Le Thomas replied that some refractories had been obtained which could resist up to 1710 degrees Cent. M. Portevin stated that he had used crucibles of specially-prepared magnesite which had resisted up to 2200 degrees, but only small crucibles can be made in such a way.

The next paper, the exchange paper of the Institute of British Foundrymen was prepared by T. Henry Turner, of the University of Birmingham, and was presented by M. Ballay, the subject being "The Alloys At Present Utilized in Great Britain". This paper has been appearing serially in recent issues of THE FOUNDRY.

The last paper presented during the morning session was entitled "A Few Dodges Used in the Making of Mechanical Castings", by G. Toussaint, foundry proprietor at Haybes-sur-Meuse, Ardennes.

Several interesting contributions were presented at the following session. The exchange paper of the American Foundrymen's association was prepared by H. Bornstein, Deere & Co., Moline, Ill., entitled "Agricultural Implement Castings". This paper was presented in the Dec. 1 and Dec. 15 issues of THE FOUNDRY. Emile Ramas, who was presiding over the session, asked E. V. Ronceray to open the discussion. M. Ronceray drew attention to the fact that the analysis of iron indicated in the paper gave the contents of phosphorus as being from 0.30 to 0.40 per cent. This, he said, is due to the fact that high phosphorus irons are only found in America in the Alabama district, which is some distance from the manufacturing center of agricultural machinery. Owing to this, the iron is obtained from Lake Superior, ores, which contain only from 0.3 to 0.4 per cent phosphorus. It is due to necessity that pig iron of this composition is employed, and it is not the ideal composition to recommend to world manufacturers.

M. Ronceray also drew attention to the output shown in the paper, and he emphasized the fact that the figures do not represent the maximum output for a large number of American foundries. He said that those foundrymen who had visited the United States in 1926 were able to notice that the agricultural machin-

ery manufacturers had less important foundries and less organized foundries than the automobile manufacturers. However, the output mentioned in the paper is certainly superior to that of French foundries, with the exception, perhaps, of two. This is due to the organization for production in American plants. To show the results that can be obtained by a thorough study of production methods, M. Ronceray stated that certain wheels for agricultural mowing machines were made in French foundries at the rate of five molds per man per day, and in a works in the north of France which is operated on American lines, the output is 150 wheels in eight hours with four men; the molds are rammed by hand, and their dimensions in one direction reach 3.3 feet.

The Belgian association presented for its exchange paper a report on the shearing test by the Fremont method. M. Le Thomas pointed out that there is no significance in studying a relation between the resistance to fracture and the resistance to shearing, because of the systematic errors that always accompany the tensile test, and because in such tests it is necessary to take account of the relative errors pertaining to each particular test.

M. Le Thomas, in collaboration with R. Bois, presented a report on "Cast Iron Testing Methods", in which the authors purported to answer to the objections made in foreign countries to the methods now recommended in France. H. de Leries, engineer at the Indret arsenal, read a paper entitled "Value of the Elastic Modulus in Perlitic Cast Iron." M. Androuin pointed out that in a large number of cases in mechanical construction, it is the co-efficient of elasticity that intervenes, and not the tensile strength.

J. Galibourg, professor at the Ecole Centrale, offered a contribution on "Castings of Special Steels", principally from the point of view of their utilization for railroad track equipment and for valves subjected to high temperatures. A. Le Thomas, naval engineer, presented a paper entitled "The Alteration of Cast Iron at High Temperatures". Following this paper, Albert Portevin stated that M. Chevinard is preparing a study on the action of sulphur in cast iron. M. Portevin also mentioned cases of deformation in long, flat castings, due to the heterogeneousness of graphitization. He also pointed out the differences which occur in the hardness of various parts of heavy castings and emphasized the fact that there is no relation between the variations of a physical property, such as expansion, and of a mechanical property, such as resistance, to rupture.

"Cast Irons Resisting Corrosion" was the title of a paper presented by Marcel Ballay. A. Portevin pointed out that the question of corrosion offers two different aspects. One calls for an economical solution, which is obtained by adding small quantities, less than 1 per cent, of inexpensive additions to the cast iron. The second is the more precise solution of using expensive additions in exact quantities, but which, of course, considerably increases the cost of production. The speaker added that there is no cast iron capable of resisting all types of corrosion.

Other papers presented included "Contribution to the Study of the Organization of Foundries" by G. Rivoire, "The Stirring of Cast Iron", by F. Girardet, and "Scientific Researches in Metallurgy", by J. Pascal.

Clamp Works on a New Principle

WITH the recent installation of a heavy duty roll-over, jolt pattern-draw molding machine, the Scullin Steel Co., St. Louis, was confronted with the problem of providing some automatic method of holding heavy flasks on the stripping plate. The problem was satisfactorily solved by the adoption of a rugged clamping device developed by the company's epecial engineer, P. J. McCullough.

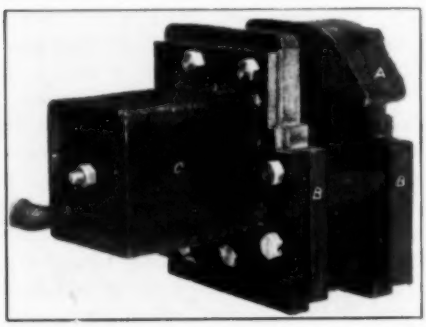


FIG. 1—THE JAW *A* MOVES BACKWARD AND FORWARD

The largest flask handled by this machine, 2 x 9 feet, 16 inches in depth, weighs 4000 pounds loaded with sand. This load is raised and dropped 3 inches, 100 times a minute during the ramming operation. After the sand is jolted, the flask, stripper plate and table are rolled over. The stripper plate, bolted to the table presents no problem, but some method must be provided for holding or clamping the flask to the stripper plate.

The automatic clamping rigging developed, takes advantage of the fact that the lower flange on all flasks is the same thickness, within a fraction of an inch. The new clamp grips this flange and by doing so the problem of handling flasks of varying heights is overcome automatically.

Among the unusual features of the device is the cylinder. What ordinarily would be called a cylinder is a square tubular chamber 4 x 4 x 5¼ inches. The piston is square and moves on a square section piston rod. The piston rod is a torque member which revolves as the piston moves forward or backward. Thus a reciprocating motion imparts a direct rotating movement.

The clamp shown in the illustration Fig. 1, works on the principle of a pair of pincers on the jaws of a vice, with *A* as the upper jaw and the extension *B* on each side of the main frame, forming the lower jaw.

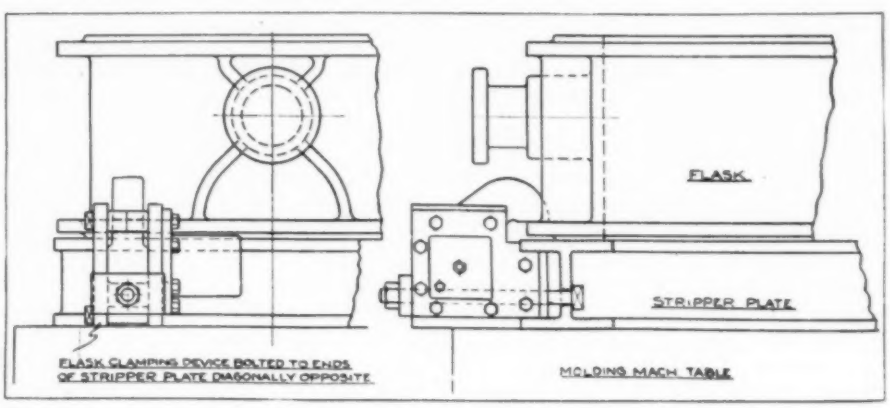


FIG. 2—SIDE AND END VIEW OF THE FLASK AND MACHINE ASSEMBLY WITH THE CLAMP IN PLACE

This pair of jaws clamps the lower flange of the flask to the upper flange of the stripper plate which in turn is bolted to the jolter table. No clamping strain reaches the bolts which hold the device on the stripper plate.

The clamping force is applied by the torque of the 1⅞-inch square shaft, 9 inches in length and helical in form for approximately half its length. The straight part extends through a square hole in the hub of the cast steel latch or jaw *A* and the twisted part extends into the square tube *C*. The torque is delivered to the square shaft piston which slides in the square tube and on the spirally shaped portion of the shaft when air is admitted at either end of the tube. The spiral shaft must rotate when the piston slides over it. Jaw *A*, connected to the shaft must open or close when the piston moves.

Piston packing shown in the illustration Fig. 1 is a piece of leather ⅛-inch thick held in close contact with springs. A later design and the one now in use, is cupped to fit around the square shaft and against the wall of the cylinder. The cupped edge of the leather is held in close contact with the rubbing surfaces by a sheet brass spring. The piston will operate without packing, but wastes the air.

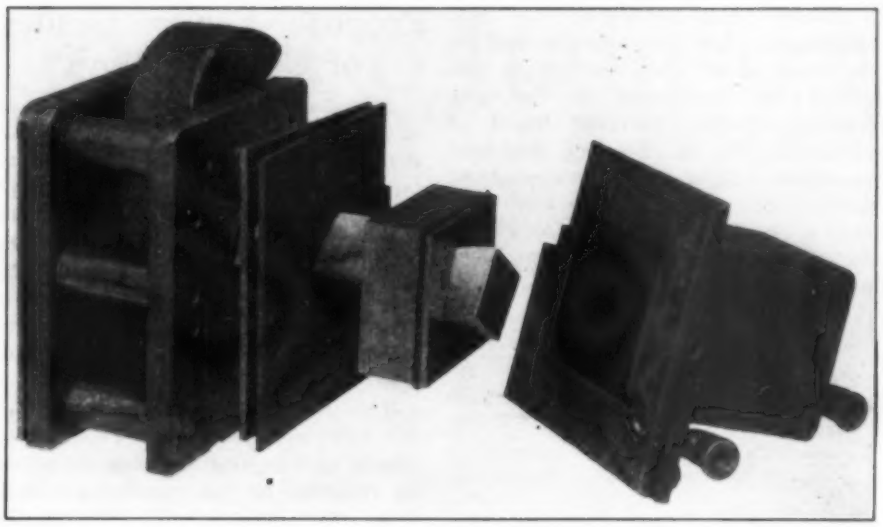


FIG. 3—THE SQUARE PISTON SLIDES ON THE TWISTED PISTON ROD AND ACTUATES THE CLAMP

Excessive wear due to high pressure on the rubbing surfaces is not anticipated, because no pressure is developed until jaw *A* makes contact. During the process of jolting the piston may creep a little under full air pressure until the weight of the flask mashes down the small film of sand that sometimes is left between the flange and the stripper plate. During the rolling process no parts rub until the weight of the flask and the sand is taken off the latch or jaw *A* by the receiving table.

On the coarse pitch or twist of the shaft only about a 3-inch piston movement is required to open or close the latch. The piston is left under air pressure either in the locked or unlocked position to take up slack, prevent wear and simplify throttle control of the clamping device.

Dedicates Cleveland Foundry School

LONG cherished dream of Cleveland foundrymen for a foundry apprentice training system became a reality with the dedication of the foundry division of the Cleveland Trade school Friday evening, Dec. 6. Approximately 150 leaders in the foundry industry, manufacturers and school officials and 26 boys enrolled in the first foundry course offered by the school, gathered in the molding room of the new foundry building for a dinner served by a group of Cleveland foundrymen.

Walter L. Seelbach, Forest City-

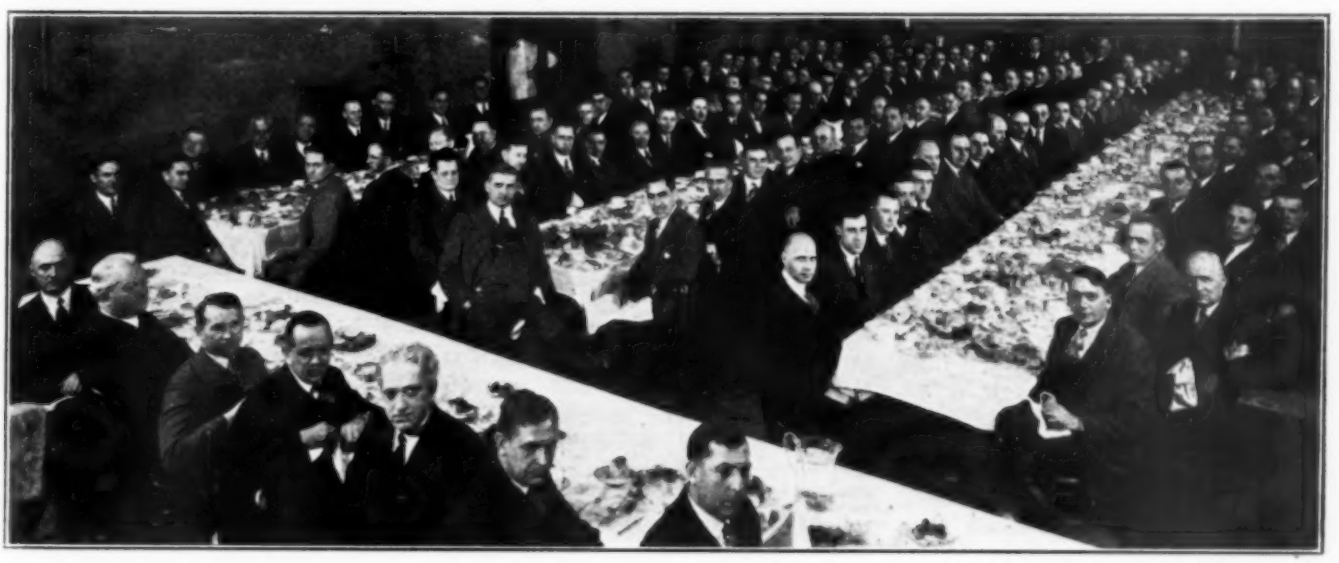


Photo by John E. Ertler & Co., Cleveland

THE DINNER WAS HELD IN THE MOLDING DEPARTMENT OF THE NEW FOUNDRY WHICH IS PART OF THE CLEVELAND TRADE SCHOOL

Walworth Run Foundries Co. was toastmaster for the occasion and in the name of the Cleveland group, presented the equipment in the new foundry to the Cleveland board of education. H. M. Buckley, assistant superintendent of schools, accepted the equipment on behalf of the board. He also spoke briefly of the place that such a school occupies in the modern scheme of education.

The address of the evening was delivered by Harold S. Falk, the Falk Corp., Milwaukee, a leader in the apprentice movement in the Milwaukee district. Mr. Falk stated that any successful apprenticeship movement is not the work of one man, but must come as the combined effort of a group. He stated that a workable plan first must be originated and then the work of the school must be correlated with the training received while the apprentice is working at the trade. He pointed to the remarkable change that has taken place with reference to working conditions in the foundry and stated this condition should attract a fine class of boys. The foundry industry is one of the most interesting of the metal working field, if properly understood, and presents many ramifications which should hold the attention of the apprentice.

Mr. Falk warned against the practice of keeping the apprentice on one job too long. It also is necessary to interest the parents of the boys in the work that is being done. This is accomplished through invitations to visit the plant and to regular reports on progress being made by the apprentice. Mr. Falk also made the startling statement that apprentice training is not an expense to the company adminstering the work. If all apprentices left the plant on completion of the course, no money would be lost by the company.

H. L. Briggs, director of vocational education, Cleveland public schools, outlined the foundry course to be administered by the Cleveland school. First year apprentices will spend all of their time in the school, devoting 3 hours a day to production work and 3 hours a day to the study of subjects closely related to the foundry course. In the second year, the boys spend one week in industry and one week in the school, and in the third and fourth years one month is devoted to work in the school and the remainder to work in industry.

Short talks also were made by M. D. Jones, principal of the Cleveland trade school, W. F. Long, American Plan association, W. J. Strangward, Forest City-Walworth Run Foundries Co., and James G. Goldie, instructor in foundry practice at the Cleveland trade school.

Propose Fewer Grades of Copper Alloys

Considerable progress in the work of collecting data needed in the formulation of a code of specifications on copper alloys in ingot form acceptable to buyers, sellers and the trade papers in the matter of quoting prices, was reported at the meeting of the joint committee on promotion of general use of specifications for copper alloys in ingot form, held at Cleveland, Dec. 10.

This committee is a special one of the American Society for Testing Materials and its findings ultimately will be reported to the regular specifications committee of the Society for final action. Co-operating in the work is the Nonferrous Ingot Metal institute, through whose aid much of the data already compiled were obtained.

Some idea of the scope of the study being made by this special committee, and the tremendous importance of the work to nonferrous metal producers and consumers is hinted in the fact that investigations already completed by the committee show that at present there are 599 separate specifications on copper alloy ingots now in use, which can be reduced to between 30 and 40 if a standard code can be formulated which will be accepted by industry as a whole.

Fully 40 alloys now being produced are known as 85-5-5-5 mixture, it was reported at the meeting, although the range of content makes such a blanket designation a decided misnomer. These 40 alloys are produced in the following range:

RANGE ON 85-5-5-5 INGOT

	Minimum per cent	Maximum per cent
Copper	83	86
Lead	4	6
Tin	4	6
Zinc	4	6
Antimony	....	0.25
Iron	....	0.35
Nickel	....	0.75
Aluminum	....	....
Sulphur	....	0.06
Phosphorus	....	0.06
Total impurities	....	0.77

This is only one instance of the wide range of specifications followed in the production of copper ingot alloys, and it was the opinion of the committee members that on red brass ingot alone the 178 specifications now in vogue readily can be reduced to two.

Resolutions were adopted at the meeting directed toward furthering the work already undertaken. The further co-operation of the Nonferrous Ingot Metal institute is to be sought in the gathering of additional facts on the uses of the various alloys.

The meeting yesterday was well attended. Those attending were: Representing the producers, G. H. Clamer of the Ajax Metal Co., Philadelphia, who presided as chairman; William Romanoff of H. Kramer & Co., Chicago, and R. D. Hollowell of the Nonferrous Ingot Metal institute, Chicago. Representing the consumers, F. L. Wolf of the Ohio Brass Co., Mansfield, O.; J. W. Bolton of the Lunkenheimer Co., Cincinnati; W. B. Price of the Scovill Mfg. Co., Waterbury, Conn.; L. B. Case of the General Motors Corp., Detroit, and the Society of Automotive Engineers, and N. K. B. Patch of the Lumen Bearing Co., Buffalo. Representing the trade and business papers, W. S. Doxsey and William M. Rooney, *Daily Metal Trade*, Cleveland; D. M. Avey of THE FOUNDRY, Cleveland. C. L. Warwick, secretary-treasurer of the American Society for Testing Materials, is secretary of the committee.

Talks on Co-Operation

The regular monthly meeting of the New England Foundrymen's association was held Dec. 11, at the Exchange club, Milk and Batterymarch streets, Boston. The meeting was held in co-operation with the Associated Brass Founders of New England and the Boston members of the American Institute of Steel Construction. Charles H. Abbot, executive director, American Institute of Steel Construction Inc., New York, was the principal speaker of the evening. His subject was "Co-operative Effort."

Club Gives Out Schedule

C. D. Waggoner, By-Products Coke Corp., Chicago, will discuss "Foundry Coke" at the January meeting of the Chicago Foundrymen's club. V. A. Crosby, metallurgist of the Studebaker Corp., South Bend, Ind., will address the February meeting, speaking on technical control and metallurgy in the foundry. Dan M. Avey, editor of THE FOUNDRY, will be the speaker at the March meeting. President H. P. Evans has appointed David G. Anderson, foundry research department, Western Electric Co., Chicago, as the club's representative in reporting activities to the American Foundrymen's association headquarters.

Manco Mfg. Co., Bradley, Ill., manufacturer of woodworking machinery, is enlarging its plant and installing additional machinery and heating and ventilating equipment. New buildings being constructed will give approximately 10,000 square feet of additional floor space.

Contributions To Industry

Win Award for

H. A. Schwartz

HARRY A. SCHWARTZ, manager of research, National Malleable & Steel Castings Co., Cleveland, has been selected to receive the 1930 major award of the American Foundrymen's association, the John A. Penton gold medal. This award, which is made to Mr. Schwartz for his outstanding contributions to the foundry industry, has been approved by the board of awards and will be presented to him at the 1930 convention, to be held in Cleveland the week of May 12.

Mr. Schwartz is noted especially for his many contributions to the field of research on malleable iron. He has been identified closely with the American Foundrymen's association for many years as a contributor of papers, as a member and chairman of various committees and as chairman of convention sessions. One of his papers was the 1928 American Foundrymen's association exchange paper to the Association Technique de Fonderie de France.

At present he is chairman of two important committees of the malleable division, namely, those on specifications and on recommended foundry practices. He also represents the American Foundrymen's association on committee A-7 of the American Socity for Testing Material on malleable iron, and on the ferrous metals committee advisory to the United States bureau of standards.

Mr. Schwartz's first paper before an American Foundrymen's association meeting was presented in 1918, on the subject of "Malleable Iron as a Material for Engineering Construction." Practically every American Foundrymen's association convention since that time has had some contribution from him in the form of a paper or written discussion.

In addition to his membership in the American Foundrymen's association, Mr. Schwartz is a member of the American Society of Mechanical Engineers, American Society for Testing Materials, Society of Automotive Engineers, American Institute of Mining and Metallurgical Engineers, the American Society for Steel Treating, the Iron & Steel institute (British), the American Chemical society, the research committee of the Malleable Iron Research institute and the Cleveland Engineering society.

He is the author of *American Malleable Cast Iron*, the outstanding book on malleable iron, which was published in 1922. In addition to his contributions to American Foundrymen's association sessions, he has presented numerous papers before meetings of the American Society for Testing Materials, American Institute of Mining and Metallurgical Engineers, American Ceramic society, American Welding society, the Society of Automotive Engineers, World Engineering congress held at Tokio, Japan, in 1929, and to the technical press.

At present he is advisor on malleable cast iron for THE FOUNDRY and is serving also as a special lecturer on the metallurgy of cast iron at the Case School of Applied Science, Cleveland. In recent years the company with which he is connected has been producing steel castings, and he has been doing research work on alloy steels, especially in connection with wear and oxidation-resisting products.

His formal technical training was obtained at Rose Polytechnic institute, Terre Haute, Ind., where he received three degrees—Bachelor of Science in 1901, Master of Science in 1903 and Mechanical Engineer in 1905. He also served as instructor at that institution in 1901-02, and has retained an active interest in the school. He served for one year as chairman of the Rose Alumni association, and for five years has been chairman of the Cleveland chapter and a member of the executive committee of the national alumni association.

Mr. Schwartz has presented the following papers and written discussions before the annual meetings of the American Foundrymen's association:

1918—Milwaukee. "Malleable Iron as a Material for Engineering Construction."

1919—Philadelphia. Discussion of paper on "Machining Qualities of Malleable Castings."

1920—Columbus. "Triplex Process for Making Electric Furnace Malleable."

1922—Rochester. "Significance of the Screen Test of Molding Sands."

1924—Milwaukee. "Oxidation Losses During Air Furnace Melting of White Cast Iron." Discussion of Report of Committee on Corrosion. Discussion of paper on "Characteristics of Pig Iron and Castings." (Characteristics that chemical analysis fails to disclose.) Discussion—"Mechanism of Graphitization of White Cast Iron and Its Application to the Malleablizing Process."

1925—Syracuse. Discussion — "The Catalysis of the Graphitization of White Cast Iron by the Use of Carbon Monoxide Carbon Dioxide Mixture When Applied Under Pressure."

1926—Detroit. "What May Be Required of Malleable Cast Iron."

1928—Philadelphia. "Oxidation Phenomena During the Annealing of Malleable Cast Iron."

1929—Chicago. "Shrinkage in White Cast Iron."

He also has presented a large number of papers before other engineering and technical societies and has written extensively for the technical press.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ If in Doubt, It's Dirty

IN THESE days of trade practice agreements between competitors, new codes of business ethics are being formulated with great frequency. Whether these result from trade practice conferences with government agencies or are the outgrowth of mutual agreement between members of trade associations, they result in the statement of elemental and obvious principles which should underlie the relations of American business men, one with another.

BOILED down to simplest terms, practically all of these codes are elaborations of the golden rule as applied to everyday business. The statement in the form of a list of rules or regulations merely sets forth those principles which everyone engaged in business would like to see his competitors follow. But how about each individual's own adherence to these principles, particularly in the foundry industry.

TRADE association executives, no matter how able, cannot act as police officers to enforce reputable business practices, either under formal trade practice rules or without them, unless it be by the consent and co-operation of the membership. Neither can the Federal Trade commission. The volition lies with the individual firm to refrain from infringement. A southern association secretary tells of looking critically, one morning, at a shirt he had worn the day before. He wondered if it would serve another day without laundering. His wife settled the question. She said, "If there is any doubt, it's dirty." Not a bad rule for general use when temptation to cut prices or to follow any other unethical, unbusinesslike procedure confronts a foundryman.

¶ Government Views Gray Iron

GRAY iron foundrymen should be interested in the "Survey of Gray Iron Foundries," which has been published recently by the department of commerce. The survey represents an analysis of statistical information secured by the bureau of foreign and domestic commerce in response to a request for such information by the gray iron industry.

IT IS to be regretted that only 646 gray iron foundries responded to the questionnaire which was sent to all plants listed in *Penton's Foundry List*. Had all foundries taken an interest in the movement and filled out the questionnaire, the results of the survey would have been far more valuable in pointing out the capacities, production, investment and other management data of vital interest to the industry.

¶ Conditions Do Not Change

WHILE many find cause for wonder and amusement in some of the practices and customs of the Orientals, it must be admitted that some of these practices possess outstanding merit and have been adopted even by the scoffers. In particular, reference is made to a practice attributed to the Chinese of engaging a physician to keep one well. The system works satisfactorily because the physician only receives payment as long as his client maintains his health. If the patient becomes ill the physician receives nothing. This idea has been adopted in many instances in this country. People do not wait until they are sick or have the toothache. Instead they pay regular visits to physicians and dentists whether they need their services or not.

THIS principle also is permeating to the industries according to an address by Dr. S. W. Stratton, president of the Massachusetts Institute of Technology recently. He drew a happy comparison between the present relation of people and doctors, and industry and the scientist. Dr. Stratton stated that industry now employs the scientist full time to keep it running correctly instead of waiting until difficulty was encountered and then send out an SOS for aid. Many foundries should take this principle to heart and would find that many of their difficulties would vanish through employment of skilled men.

DR. STRATTON also called attention to another feature of present-day development, and that is the work is done in pure science. Previously, this work had been considered not unlike the ungainly stepchild. It had been looked upon as an abstract science without relation to anything else. Now many firms are engaged in research in this branch of science, and are discovering that many principles developed can be applied practically either directly or indirectly.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

J TRANTIN, Jr., formerly metallurgical engineer, Minneapolis Electric Steel Castings Co., Minneapolis, has accepted a similar position with the Fort Pitt Steel Casting Co., McKeesport, Pa. Prior to his connection with the Minneapolis company, he was metallurgist and director of research, Pettibone-Mulliken Co., Chicago; metallurgist and chief chemist, Alemite Die Castings & Mfg. Co., Chicago; industrial engineer, L. V. Estes, Inc., Chicago; foundry superintendent, Piston Ring Co., Muskegon, Mich.; metallurgist research engineer, Western Electric Co., Chicago and metallographist, Illinois Steel Co., South Chicago, Ill. During the war Mr. Trantin served as civilian in charge of manufacture of gun mounts at the plant of the Goss Printing Press Co., Chicago, for the U. S. naval ordinance department and was metallurgical advisor for the central district. Mr. Trantin was born in Chicago on Nov. 29, 1892. He was graduated from the University of Wisconsin in 1915 with a degree in chemical and metallurgical engineering.

John E. Galvin, president, Ohio Steel Foundry Co., Lima, O., is a member of a nonpartisan committee of 100 members, appointed recently by Governor Myers Cooper to draft a new system of tax laws for the state of Ohio.

George W. Driver for the past 10 years assistant manager of the malleable plant of the American Radiator Co., New York, has been appointed manager of the malleable and steel plants of the company located at Buffalo.

W. L. Boyer, vice president and secretary of Canadian Bronze Co. Ltd., has been elected president and managing director to succeed P. R. Diamond, who has become chairman of the board. E. S. Caie, formerly assistant secretary, has been promoted to secretary and W. C. Paquette becomes assistant secretary.

Bertram G. Parker has been elected president of the Youngstown Foundry & Machine Co., Youngstown, O., succeeding W. J. Wallis, who has been made chairman of the board. Mr. Wallis had been head of the company 40 years and retires at the age of 75. Mr. Parker was vice president and general manager for the past eight years and has been identified with the company for more than 30 years.

Charles E. Mitchell has been appointed associate manager of the Gray Iron institute to assist Arthur J. Tuscany, manager, in the executive work. Mr. Mitchell's duties will deal with accounting, merchandising and association promotional work. He was accountant and office manager for the Bell Telephone Co., Cleveland, for 10 years when he left that company to become salesman, sales organizer and

CHARLES E. MITCHELL

sales director. Mr. Mitchell formerly was manager of a local Cleveland association which he directed with success. He resigned that position to become associate manager of the Gray Iron institute.

Adolph Volderaur, secretary and general manager of the Vulcan Plow Co., Evansville, Ind., for the past several years and identified with the company for nearly 30 years, has been named vice president to succeed the late G. Arthur Trimble. Mr. Volderauer also becomes general manager of the Evansville plant.

C. A. Hines, manager of the Roderick Lean plant, Mansfield, O., of the Vulcan Plow Co., Evansville, Ind., was selected general mangaer of the four plants operated by that company including Mansfield and Evansville, Hayes Pump & Planter Co., Galva, Ill., and the Peoria Drill & Seeder Co., Peoria, Ill. He also was made treasurer of the Vulcan company.

William W. Maloney, formerly on the staff of the *Iron Trade Review* and the *Daily Metal Trade* published by the Penton Publishing Co., Cleveland, has accepted a position with the American Foundrymen's association. He will assist in the publication of a new monthly magazine, *Transactions and Bulletin*, which will make its initial appearance with the January, 1930 issue. Mr. Maloney was born in Chicago and received his education in the public schools of that city and at the University of Illinois from which he was graduated with the degree of bachelor of science in commerce and adminstration.

George C. Small, vice president, United Engineering & Foundry Co., Pittsburgh, has resigned effective Jan. 1, and will retire from active business. He was affiliated with the United company and its predecessor for 36 years. Mr. Small was born near East McKeesport, Pa., in 1864, and received his education in the public schools, local academies and the Indiana State Normal at Indiana, Pa. Later he became identified with the Apollo Foundry Co. and the Apollo Iron & Steel Co. at Apollo, Pa. The latter concern now is the Vandergrift plant of the American Sheet & Tin Plate Co. He became connected with the Lincoln Foundry Co. in 1893. In 1901, when the United Engineering & Foundry Co. was organized, he was made manager of the Lincoln Foundry Co. department. In 1905 he was elected second vice president and in 1915 was made first vice president of the company. Mr. Small has given special attention to the manufacture of chilled, sand and alloy iron rolls.

Accepts New Position

Charles M. Nuckolls has resigned his position with the International Harvester Co., Chicago, and has accepted a position with the H. D. Conkey & Co., Mendota, Ill. Mr. Nuckolls will have charge of design and development in the crane department of the Conkey company. Prior to his connection with the International company, he was associated with the Whiting Corp., Harvey, Ill. and the Shaw Crane Works, Muskegon, Mich.

Obituary

George G. Harvey, 57 years old president, A. Harvey's Sons Mfg. Co., Detroit, plumbing supplies, etc., died in that city Nov. 18.

William H. Rea, former treasurer of the Mesta Machine Co., Pittsburgh, died Dec. 15 at his home in Pittsburgh. Mr. Rea was secretary of the Iron Roll association for nearly 50 years. He was 73 years old.

Louis Duffke, 66, secretary-treasurer and one of the founders of the Nortmann-Duffke Foundry Co., Milwaukee, died Nov. 18.

Charles F. Blue Jr., at one time vice president of the Carbon Steel Co., Pittsburgh, died at his home in Oakmont, Pa., Nov. 26. He formerly was associated with the Pittsburgh Iron & Steel Foundries Co. as vice president and plant manager.

Maurice A. Oudin, 63 years old, vice president of the International General Electric Co., died at his home in Schenectady, N. Y., Dec. 4. He joined the Thomson-Houston Electric Co. of Lynn, Mass., in 1891 and continued in various capacities with its successor, the General Electric Co. He was active in the power and mining interests, and served for a time as acting district manager of the Denver territory.

Harry Edward Packer, assistant superintendent, Springfield, Mass., plant of the Westinghouse Electric & Mfg. Co., died Nov. 25, after brief illness, at his home in Springfield. He was born in Noank, Conn., Dec. 11, 1880 and had resided in Springfield for the past 19 years.

G. Arthur Timble, 51 years old, vice president and general manager of the Vulcan Plow Co., Evansville, Ind., died Nov. 25. He also was president of the D. Roderick Lean Co., Mansfield, O.; the Hayes Pump & Planter Co., Galva, Ill.; the Peoria Seed & Driller Co., Peoria, Ill., and was secretary-treasurer of the South Bend Chilled Plow Co., South Bend Ind.

Robert T. Huston, vice president and superintendent, Connersville Blower Co., Connersville, Ind., died suddenly at his home in that city, Nov. 14. He had been connected with the company since its organization in 1893. In addition to his interest in building up and maintaining the plant's equipment and efficiency, he was active in other industrial, civic, lodge and social work of his city.

Fred D. Holdsworth, engineer in charge of air compressor design at the Claremont, N. H., plant of the Sullivan Machinery Co., 400 North Michigan avenue, Chicago, from 1900 to 1928, died recently. He was born in Wales, Mass., in 1867 and was graduated from Worcester Polytechnic institute in 1888. After experience as mechanical engineer with the Rhode Island Locomotive Works and with the G. F. Blake Co., afterward Blake & Knowles, he became affiliated with the Sullivan staff in 1900. He retired about a year ago.

Warren E. Mumford, metallurgist, Malleable Iron Fittings Co., Branford, Conn., died at his home in that city, Nov. 15. He was born in Webster, Mass., in 1869 and received his early education in the schools of Webster and Worcester, Mass. He was graduated from Worcester Polytechnic institute in 1890 and in the same year entered the employ of the American Steel Car Wheel Co., as chemist and metallurgist. He spent most of the following 20 years in Muskegon, Mich.; Dunkirk, Indiana, York and Berwick, Pa.; Akron, O., and St. Louis. In 1913 he entered the employ of the Malleable Iron Fittings Co., where he remained until his recent death.

Foundry Association Directory

American Foundrymen's Association

President, FRED ERB, Erb-Joyce Foundry Co., General Motors building, Detroit; executive secretary treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, GEORGE W. THORNBURG, Crescent Park Brass Foundry, Watham, Mass.; secretary, R. B. BONNER, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fouth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Pettibone-Mulliken Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Car Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, DON MCDANIEL, Hamilton Foundry & Machine Co., Hamilton, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association

President, JOHN S. SCHOFIELD, J. S. Schofield's Sons Co., Macon, Ga.; Secretary, W. E. DUNN JR., Flatiron building, Atlanta, Ga.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York. Meetings: Chicago Jan. 28, and Cleveland, May 12-15, 1930.

Tri-City Technical Council

Chairman, C. F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. XANDER, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue, Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, R. D. BONNEAU, Commutator Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Trade Trends in Tabloid

PASSENGER car production in November dropped to about 225,000 units, the lowest monthly output since January, 1928. However, the year's total to date of all classes of cars for the United States is nearly five and a quarter million.

—T-T—

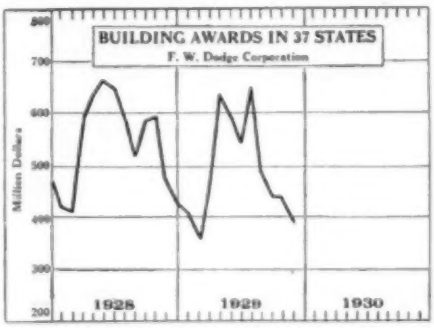
Iron, steel and copper prices show no change. Foundry pig iron prices have been unchanged during the last three months of the year.

—T-T—

Cast iron pipe inquiry is active, but prices are weak. Operations in southern pipe shops range from 40 to 60 per cent of capacity.

—T-T—

Demand for electrical goods during 1929 was the highest on record. Sales of motors, batteries, radios, domestic



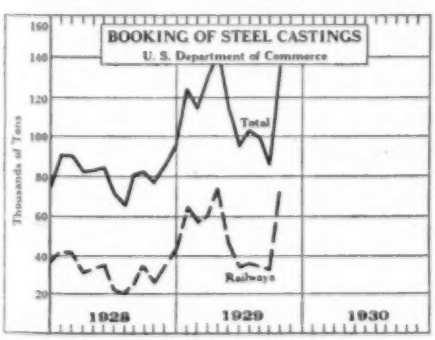
electrical appliances and industrial machinery during the first 10 months averaged 111 million dollars a month compared with 83 million per month for the corresponding period of the previous year.

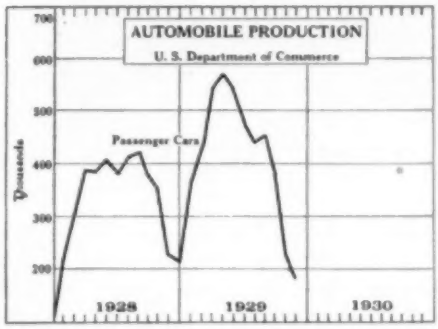
—T-T—

Early reports of retail trade during the Christmas season report a greater volume of medium priced goods, more than compensating the decline in purchases of high priced items.

—T-T—

Bookings of steel castings for November totaled 88,424 tons, or 61 per





cent of capacity, according to department of commerce reports covering 127 reporting companies. Production for the month was at the rate of 71 per cent of capacity, compared with 81 per cent in October and 59 per cent for November, 1928.

—T-T—

The aggregate budget of Class I railways for equipment purchases during 1930 is 370 million dollars. Roadways, signals, track improvements and structures costing 680 millions also are projected.

—T-T—

November machine tool orders were 55 per cent of the preceding month, but backlog orders are at hand sufficient to maintain operations for two months.

—T-T—

The National Business Survey conference held Dec. 5 under auspices

RAW MATERIAL PRICES

Dec. 24, 1929

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	21.26 to 21.76
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.50
Basic, Buffalo	18.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.75 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$15.00 to 15.50
Heavy melting steel, Pitts	15.00 to 15.50
Heavy melting steel, Chicago	12.50 to 13.00
Stove plate, Buffalo	12.00 to 12.25
Stove plate, Chicago	10.25 to 10.75
No. 1 cast, New York	10.85
No. 1 cast, Chicago	13.50 to 14.00
No. 1 cast, Philadelphia	15.50 to 16.00
No. 1 cast, Pittsburgh	15.50 to 16.00
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	16.50 to 17.00
Agricultural mal., Chicago	13.75 to 14.25
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.00 to 17.25
Electro, copper, producers	18.00
Straits, tin	39.37½
Lead, New York	6.25
Antimony, New York	8.35
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.25 to 16.75
Zinc, East St. Louis, Ill	5.45 to 5.50

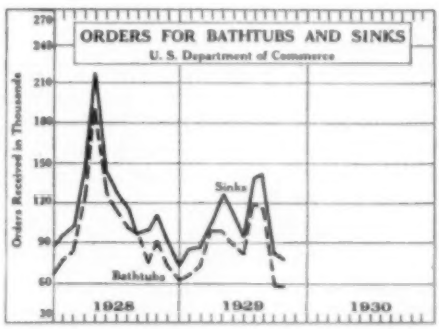
of the Chamber of Commerce of the United States stressed the importance of maintaining the level of production and keeping up employment to sustain the buying power. Public construction activities involving two and a half billion dollars are projected.

—T-T—

Railroads bought more freight cars in 1929 than in any one of the past five years, and the end is not in sight. Over 100,000 freight cars were purchased during the year.

—T-T—

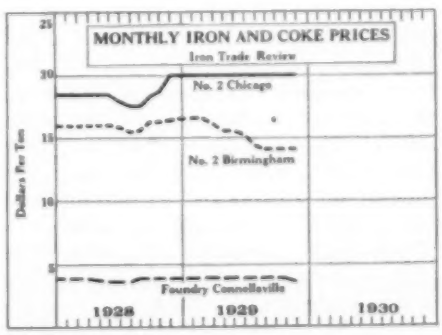
Department of commerce figures for the malleable castings industry show operations at 44 per cent of capacity with orders during November totaling 35,985 tons. These figures are preliminary and are based on actual reports from 99 firms with a capacity of 71,590 tons.

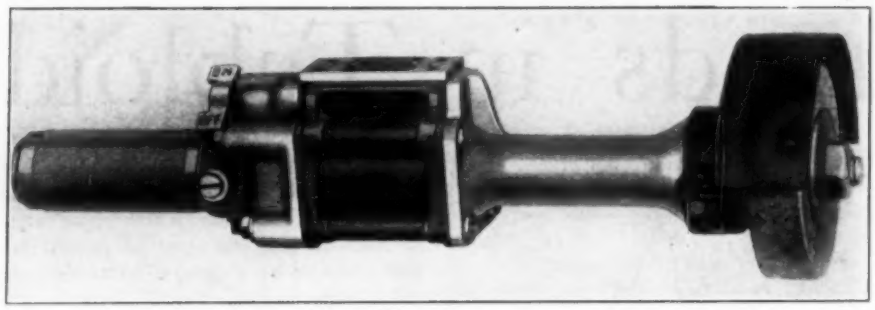


Many of the steel foundrymen attending the recent meeting in Pittsburgh stated that they have secured a higher price for castings during recent months. One producer pointed to a price $13 per ton higher than a year ago.

—T-T—

Foote Bros Gear & Machine Co., Chicago, has booked orders for road-building machinery in sufficient volume to keep the plant operating at full capacity for more than four months, it is stated by W. C. Davis, president.





THE MACHINE IS EQUIPPED WITH ANTIFRICTION BEARINGS

Designs New Grinder

Black & Decker Mfg. Co., Towson, Md., recently has introduced a new 6-inch, ball-bearing, portable, electric, bench grinder. The machine is equipped with antifriction bearings making it easier to maintain wheel speeds under load. It is fitted for alternating current only, giving a 3600 revolution per minute spindle speed on 60 cycles and 3000 revolutions per minute on 50 cycle current.

Gives Equipment Orders

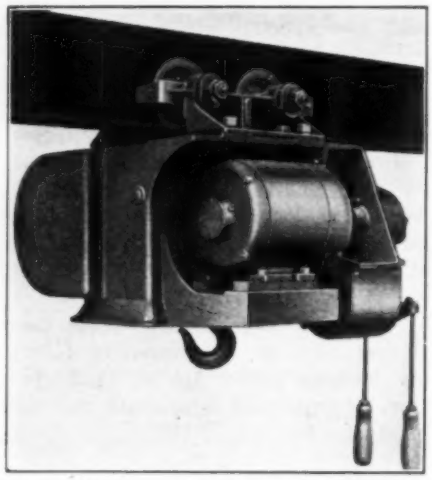
The index of gross orders for foundry equipment for November was 128.6 as compared with 245.3 for October, according to a recent report of the Foundry Manufacturers' association. The index of shipments for November was 152.2 as compared with 214.1 for October. Unfilled orders for November were 445.4 against 492.5 for October. The base is the average monthly shipments for the years 1922-23-24. Comparison of monthly orders as presented by the association follow:

Month	1926	1927	1928	1929
Jan.	168.2	180.4	132.7	180.5
Feb.	154.9	198.0	123.6	197.0
March	157.3	131.1	138.6	209.4
April	113.2	130.0	107.7	172.6
May	128.5	134.8	335.6	177.7
June	133.5	138.4	149.1	177.3
July	127.3	89.9	94.8	219.3
Aug.	141.2	106.4	278.0	229.5
Sept.	114.0	80.4	170.0	216.3
Oct.	140.5	98.0	185.0	245.3
Nov.	133.4	95.8	197.8	128.6
Dec.	181.0	106.8	166.5	.....

Introduces New Hoist

Robbins & Myers Inc., Springfield, O., recently has placed on the market the new electric hoist shown in the accompanying illustration. It is equipped with motors manufactured by the company and has a lifting capacity of from 250 to 15,000 pounds. The hoist has been designed so that the parts easily are accessible. The entire hoisting mechanism may be withdrawn through the front of the main frame after the cover has been removed and the motor and brake and the controller removed in units.

The main frame of the hoist is a one-piece casting. Two reductions of spur gearing are used, the motor pinions being hobbed directly to the motor shaft and the drum and motor gears in alloy steel heat treated rings pressed and keyed on spiders. Shafting of the hoist is of alloy steel and the machine is equipped with roller bearings made by the Hyatt Roller Bearing Co., Newark, N. J. The load is controlled by a Weston type load brake and the motor brake is operated mechanically from the controller.



HOIST HAS A LIFTING CAPACITY OF FROM 250 TO 15,000 POUNDS

The drum is of deep flange construction designed to give minimum wear on the rope. The hoist is equipped with cast steel trolleys operating on ball or roller bearings. The motor is of the totally enclosed, ball bearing, high torque type made according to standard specifications of the company. Electrical equipment includes adjustable current collectors, controller, and limit switch.

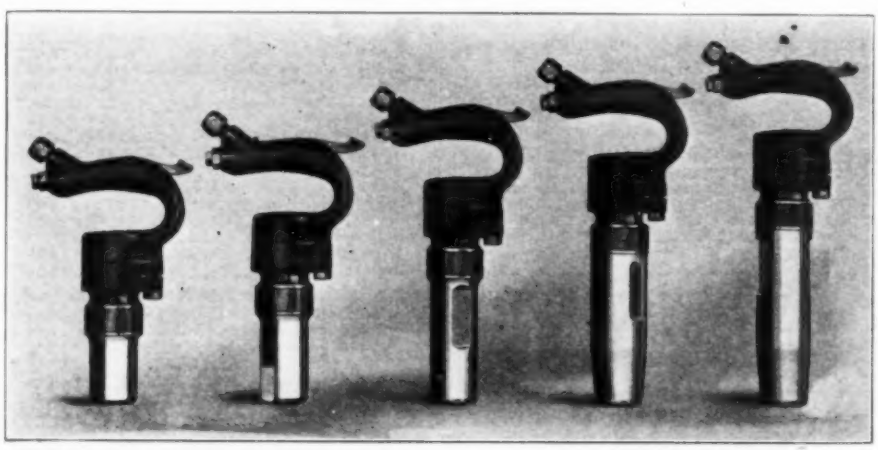
General Steel Castings Buys Two Plants

The General Steel Castings Corp., Eddystone, Pa., has arranged to purchase the steel foundry of the American Locomotive Co. Chester, Pa., and the Thurlow plant of the American Steel Foundries also at Chester. The plants are near Eddystone, Pa., where the General Steel Castings Corp. is building a large plant adjoining the Baldwin Locomotive Works.

Introduces New Type of Chipping Hammer

Ingersoll-Rand Co., 11 Broadway, New York, recently has introduced a new line of high-speed pneumatic chipping hammers which have several new features. A flapper-type valve is used in the hammer, which permits a shorter length and a reduction in weight. The valve is a thin beveled plate which flaps up and down on its seat to open and close the air ports. The valve is in a valve box and gives positive action.

Another feature of the new hammers is the throttle valve, a combination piston and poppet valve, which allows fine graduation of the air port openings. Open handles are standard equipment. The handle screws on the barrel of the hammer and is locked in place securely with a new type pinch bolt arrangement. Exhaust is through the side of the barrel and may be deflected in any desired direction by an adjustable exhaust deflector. Hammers are made in five sizes, with strokes of ¾, 1, 2, 3, and 4 inches.



THE HAMMERS ARE MADE IN FIVE SIZES. A NEW TYPE VALVE PERMITS REDUCTIONS BOTH IN LENGTH AND WEIGHT

Gray Iron Institute Appoints Committees

The executive committee of the Gray Iron institute, Terminal Tower building, Cleveland, has confirmed the appointment of the following committees for the ensuing year:

Cost Committee

John L. Carter, Sacks-Barlow Foundries, Inc., Newark, N. J., chairman; G. E. Finck, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; William J. Grede, Liberty Foundry, Inc., Wauwatosa, Wis.; A. E. Hageboeck, Frank Foundries Corp., Moline, Ill.; P. E. Rentschler, Hamilton Foundry & Machine Co., Hamilton, O.; F. C. Schimpf, Olney Foundry Co., Philadelphia; L. C. Vallier, Buffalo Foundry & Machine Co., Buffalo.

Finance and Budget Committee

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Merchandising Committee

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Research Committee

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Trade Information Committee

Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis, chairman; Harry Graham, Bond Engineering Works, Toronto, Ont., Can.; W. J. Grede, Liberty Foundry Inc., Wauwatosa, Ill.; C. B. Magrath, Northwestern Foundry Co., Chicago; Charles S. Parker, Chas. Parker Co., Meriden, Conn.; W. E. Stephen, Roberts & Mander Stove Co., Philadelphia.

Trade Practice Committee

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The personnel of the membership committee will be announced in the near future. The institute, soon will have ready for distribution the standard cost finding system which the cost committee of the institute has been working on for the past several months. The cost work has been under the direction of John L. Carter.

Reduces Blistering

According to the annual report of the director of the bureau of standards, the gas which causes blisters in an enamel when applied to some iron castings appears to be principally carbon dioxide with some carbon monoxide admixed. This evolution of gas may occur without damage at certain stages of the enameling process, but from a blistering iron continues through the critical stage of the enameling during which the relatively thick finish coat of enamel is fused and too viscous to permit free escape of the gas. The evolution of gas during the critical period appears to be caused by the break down of combined carbon and its recombination with oxygen, and is controlled by the amount and condition of the combined carbon in the surface of the casting to which the enamel is applied. Experiments have shown that it is possible to modify the nature of this surface layer so as to reduce greatly blistering through the addition of certain elements to the iron, notably silicon which diminishes the proportion of combined carbon.

The first International Heating and Ventilating exposition will be held in Philadelphia, Jan. 27 to 31, 1930. Automatic heating and ventilating equipment will be studied as well as methods of heating and design. As a special feature of the exposition a section will be devoted to historical and educational exhibits depicting the progress of heating and ventilating.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Shoewe Foundry Co., Detroit, has changed its name to Service Foundry Co.

Chapman Valve Mfg. Co., Springfield, Mass., will make extensive improvements and alterations to its foundry.

H. P. Deuscher Co., Seventh and Hanover streets, Hamilton, O., has been issued a permit for the construction of a foundry addition.

Schroeder Machine Co., 15139 Rippelle street, Detroit, has been incorporated with $100,000 capital to operate a foundry and machine shop, by August Schroeder.

Electric Steel Castings Co., Speedway City, Indianapolis, has awarded construction contract for a 1-story plant building, 54 x 200 feet, estimated to cost about $44,000.

Ohio Steel Foundry Co., Springfield, O., plans to occupy its new building, 100 x 200 feet, for the production of alloy steel castings. (Noted Aug. 1.)

William Powell Co., 3233 Colerain avenue, Cincinnati, manufacturer of brass and iron specialties, closed bids Dec. 10 for a 1-story and basement plant addition.

York Ice Machinery Corp., Market street, Canton, O., is considering expansion of production facilities of its dairy equipment division.

Coady Bros., 1405 Bloor street west, Toronto, Ont., manufacturers of motor truck bodies, has purchased the greater portion of the old Bigley foundry property on Wabash avenue.

W. Bingley & Sons Ltd. has been incorporated in Cornwall, Ont., to operate a machine shop, foundry, shipwright and dock repair business.

Hudson Foundry Co. Inc., Harrison, N. J., has been incorporated by James A. Lynch Jr., 9 Clinton street, Newark, N. J., to operate a foundry.

Brooks Foundry Co., 515 Marietta street, Atlanta, Ga., awarded a contract for the construction of a 1-story foundry building, 30 x 40 feet, to the A. K. Adams & Co., 542 Plum street northwest.

Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., recently reopened its second foundry in Muskegon which has been closed for the past 60 days.

Pattern Engineering & Mfg. Co., Beechwood, O., has been incorporated with 250 shares of no par stock, by Bartholomew, Leeper & McGill, attorneys, Engineers Bank building, Cleveland.

Miller Pattern Co., Toledo, O., recently incorporated by Marshall, Melhorn, Marlar & Martin, attorneys, Spitzer building, is said to have plans for building a plant at Sylvania avenue and Toledo Terminal railroad.

National Broach & Machine Co., Detroit, has been incorporated with $225,000 capital by Robert S. Drummond, 1168 Boston boulevard west, to manufacture machinery, tools and castings.

William Ganshow Co., 1001 Washington

boulevard, Chicago, has been incorporated with 100 shares of no par stock to manufacture and deal in castings, forgings and machinery, etc., by William H. Chamberlain.

American Art Metal Works Inc., Detroit, has been incorporated to manufacture and deal in die castings, tools and automobile hardware, by John Hartman, 5036 Twenty-third street.

American Brake Shoe & Foundry Co. of California, which has been operating in leased quarters at Los Angeles, has bought a site on Slauson avenue and will build a foundry with 20,000 square feet of floor space.

Trinity Valley Iron & Steel Co., Fort Worth, Tex., has completed installation of sand blasting and mixing equipment for the manufacture of ornamental castings. The company also will enlarge pattern storage capacity. O. K. Black is manager.

Cincinnati Steel Castings Co., 1220 Queen avenue, Cincinnati, awarded a contract for the construction of a 1-story foundry building, 90 x 290 feet, to D. Meinken & Son, 2143 Barnard avenue. Estimated cost of building is $20,000.

St. Joseph Electric Steel Castings Co., St. Joseph, Mich., advises it is building a 3-story foundry addition, 40 x 60 feet. Contract has been let to M. W. Stock & Sons Construction Co., Benton Harbor, Mich. Molding and sand handling equipment will be purchased.

November sales of the Kalamazoo Stove Co., Kalamazoo, Mich., exceeded the sales in the same month last year by 43.6 per cent. For eleven consecutive months the sales of the company have been larger than in the corresponding months in 1928.

Wilcox Crittenden & Co. Inc., South Main street, Middletown, Conn., manufacturer of marine hardware, is receiving bids for the construction of a one and 2-story foundry and boiler house addition. Lockwood, Greene & Co. Inc., 24 Federal street, Boston, is engineer.

Standard Aluminum Co., Lansing, Mich., has bought the real estate, buildings and equipment of the Standard Casting Co., also of Lansing. Business of the latter was taken over by the Aluminum Casting Co. about six months ago. The acquisition of the real property is to give needed expansion in production.

Expansion plans for the Centre Foundry & Machine Co., Wheeling, W. Va., have been announced by President J. H. Young. Plans call for expenditure of $22,000 including enlargement of the Warwood plant and additional equipment. A 10-ton crane is to be installed.

The factory and equipment of the Dennison Foundry Co., Dennison, O., has been purchased by Ferguson & Edmonson Construction Co., with headquarters in Toledo and Sandusky, O. All equipment from the Toledo and Sandusky shops will be moved to the new Dennison plant and headquarters will be established there.

Duriron Co. Inc., New York and Dayton, O., has started a plant enlargement program touching the Dayton plant and the eastern foundry at Newark, N. J. This company and Industrial Welded Alloys Inc., both divisions of Industrial Alloy Products Corp. have become affiliated in sales engineering and manufacturing. Duriron foundries have put in service new electric furnaces of high-frequency and arc types. Castings up to 10,000 pounds will be produced. Products include duriron, duriment, and other alloy steels and monel metal and nickel. A line of pumps and other standard products will be available shortly in various alloy steels. A fireproof laboratory is nearing completion at Dayton, including complete chemical and physical testing departments and an experimental foundry, rolling mill and machine shop.

New Trade Publications

BRICK—Laclede-Christy Clay Products Co., St. Louis, has issued a folder on the uses of its brick.

MOTOR-GENERATOR SETS—General Electric Co., Schenectady, N. Y., in a current bulletin describes its induction motor-generator sets of ⅞ to 35 kilowatts, 125 to 250 volts.

WELDING—Instructions for welding, soldering and brazing monel metal and pure nickel have been revised and issued as a bulletin by the International Nickel Co., New York.

SPEED REDUCERS—Janette Mfg. Co., Chicago, in a current bulletin, gives specifications of a worm-and-gear speed reducer and describes special designs for special conditions.

CORE DRYING EQUIPMENT—Drying Systems, Inc., 1800 Foster avenue, Chicago, is circulating a description of the installation of its equipment in the core room of the Studebaker Corp., South Bend, Ind.

REFRACTORIES—A description of its plant, with illustrations, has been prepared in booklet form by the Kier Fire Brick Co., Pittsburgh. Manufacturing processes are illustrated and described.

TRAMRAILS — Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a folder on the many uses of its tramrail equipment in the foundry.

CORE OVENS—Swartwout Co., 18511 Euclid avenue, Cleveland, has issued a folder that describes the features of its line of core ovens. The folder also contains several reproductions from photographs of typical installations.

WELDING RODS — Fusion Welding Corp., 103rd street and Torrence avenue, Chicago, has issued a folder that describes the properties and the technique necessary for the use of its special welding rod for austenitic alloy steels.

CONVEYORS—Use of chain trolley conveyors in industry is sketched in a bulletin by the Mathews Conveyor Co., Ellwood City, Pa. Illustrations show actual applications in moving parts in process.

GEARS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes in a recent folder the advantages of using its heat treated and hardened gears. Charts and tables are used as comparative data.

PORTABLE ELECTRIC TOOLS—Chicago Pneumatic Tool Co., New York, has issued a catalog of its portable electric tools. Illustrations present the tools and their applications, with color adding to effectiveness. Specifications are furnished for each tool.

ZINC—New Jersey Zinc Co., 160 Front street, New York, recently has issued a pamphlet on the use of zinc as a die casting alloy. It is well illustrated with reproductions from photographs of sample die castings where a zinc alloy was used.

CUPOLA FLUX—Sulfex Corp., 52 Broadway, N. Y., has issued a booklet on the use of its flux in the cupola for the removal of sulphur. The advantages of its use, its effect on cupola operation and reduction of scrap castings are discussed.

BLOWERS — Connersville Blower Co., Connersville, Ind., in a current bulletin describes and illustrates in detail many of the features of its Boston type, rotary, positive blowers with medium capacities at normal pressures up to 10 pounds per square inch.

FURNACES—General Electric Co., Schenectady, N. Y., has issued a folder describing its mesh-belt, conveyor furnace to be used for heat treatment of small parts at temperatures up to 1650 degrees Fahr. Sectional views of the furnace feature the bulletin.

ISOLATION—Korfund Co. Inc., New York, has issued the first of a regular publication on scientific, practical and economical application and study of materials and methods of deadening and eliminating vibration and noise. It will be published quarterly for all who are interested in this subject.

FOUNDRY OVENS—Despatch Oven Co., Minneapolis, has issued two bulletins featuring core and mold ovens for foundry use. They may be equipped with electric, gas or oil heating systems and automatic control is optional. They are illustrated and give full description of operation.

LIFTS—Lewis-Shepard Co., 174 Walnut street, Watertown station, Boston, has published a folder on its lift trucks, stackers and skid platforms. The folder is illustrated with views showing the various uses of the several type lift trucks that the company manufactures.

NONCORROSIVE CASTINGS—William J. Sweet Foundry Co., Inc., Irvington, N. J., specializing in noncorrosive and heat resisting castings, has a new enlarged chart for distribution which gives detailed information concerning analyses, physical properties, corrosive media and recommended uses of its castings.

STARTERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published a booklet on its linestarters for induction motors. The booklet describes and illustrates that equipment and shows several reproductions from photographs of typical installations. The various features of the linestarters and linestart motors also are discussed.

FOUNDRY EQUIPMENT—Fordath Engineering Co., Ltd., Hamblet Works and West Bromwich, England, recently has published a bulletin on its core oils and foundry equipment. The booklet is well illustrated with reproductions from photographs of cores in which their core oils were used, and castings from the same kind of cores. A description of its sand mulling and core making equipment is included.

CONVEYORS—Saginaw Stamping & Tool Co., Saginaw, Mich., has published a 42-page bulletin on its conveyor equipment. The booklet is illustrated with detail and assembly views of the various types of conveyors that the company manufactures together with drawings and reproductions from photographs of typical installations. Tables of dimensions and list prices are included.

PYROMETERS—Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, has issued its revised catalog No. 86 on optical pyrometers. It too is distributing its new revised catalog No. 87 on "Potentiometer Pyrometers" and a complete revision of its catalog No. 93 on "The Homo Method for Production Tempering." Notebook No. 4 is a new publication entitled "Notes on the Kelvin Bridge." These publications are illustrated and describe their respective subjects in a complete yet understandable way.

INDUSTRIAL LIGHTING — Detroit Steel Products Co., Detroit, has issued a 24-page booklet explaining the principles of daylighting in industrial buildings. Twenty-five points are discussed in the book that have a bearing on the subject. The booklets are written in such a way as to be of value to architects, engineers, plant executives, plant owners who wish to alter lighting conditions in the plant or who are contemplating plans for industrial buildings. The booklet is illustrated well with diagrams which show data on the various subjects discussed.

A New Years Greeting

(From a mellowing tablet in Chester Cathedral)

Give me a good digestion, Lord,
And also something to digest,
Give me a healthy body, Lord,
With sense to keep it at its best.

Give me a healthy mind, good Lord,
To keep the good and pure in sight,
Which seeing sin is not appalled,
But finds a way to set it right.

Give me a mind that is not bored,
That does not whimper, whine or sigh,
Don't let me worry overmuch
About the fussy thing called I.

Give me a sense of humor, Lord,
Give me the grace to see a joke,
To get some happiness from life,
And pass it on to other folk.

And wishing you all a happy and prosperous New Year

Sincerely

Lawrence Murray

President

Albany Sand & Supply Co.
Albany, N. Y.

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A classified-by-products list of advertisers for the convenience of readers. If you don't find what you want, write us and we will tell you where to get it. ¶Index to advertisements will give you page number of any advertiser and by referring to advertisement you can get full particulars about products.

ABRASIVE BRICKS—Rubbing

Abrasive Company, Tacony & Fraley Sts., Philadelphia.
Cleveland Stone Co., Union Trust Bldg., Cleveland, O.
Norton Co., Worcester, Mass.
Sterling Grinding Wheel Co., Tiffin, O.

ABRASIVE FILES

Cleveland Stone Co., Union Trust Bldg., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.

ABRASIVE WHEELS

Abrasive Company, Tacony & Fraley Sts., Philadelphia.
Carborundum Co., Niagara Falls.
Cleveland Stone Co., Union Trust Bldg., Cleveland, O.
Haskins, R. G., Co., 4635 Fulton St., Chicago, Ill.
Norton Co., Worcester, Mass.
Safety Grinding Wheel & Machine Co., Springfield, O.
Sterling Grinding Wheel Co., Tiffin, O.
Strand, N. A., & Co., 5001-5009 North Lincoln St., Chicago, Ill.

ABRASIVES—Metallic Sandblast

American Steel Abrasive Co., Galion, O.
Globe Steel Abrasive Co., The, Mansfield, Ohio.
Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Sly, W. W., Mfg. Co., 4702 Train Ave., Cleveland, O.
Steelblast Abrasives Co., Cleveland, O.
Steel Shot & Grit Co., Amesbury, Mass.

ACETYLENE DISSOLVED or in Cylinders

Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

ACETYLENE Generators

Oxweld Acetylene Co., Newark, N. J.

AIR COMPRESSORS

Bury Compressor Co., 1746 Cascade St., Erie, Pa.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York City.
General Electric Co., Schenectady, N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Sullivan Machinery Co., 400 No. Michigan Ave., Chicago, Ill.

AIR CONDITIONING Equipment

Drying Systems, Inc., 1801 Foster Ave., Chicago, Ill.

AIR SEPARATORS—See Separators—Air, Moisture, Oil

AIR TOOLS—See Tools—Pneumatic

ALLOYS

Electro Metallurgical Sales Corp., 30 E. 42nd St., New York City.
Metal & Thermit Corp., 120 Broadway, New York City.
Niagara Falls Smelting & Refining Corp., 2204 Elmwood Ave., Buffalo.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

ALLOYS—Boronic

American Boron Products Co. Inc., Ramsdell and Elmwood Ave., Buffalo, N. Y.

ALUMINUM—Alloys & Ingots

Niagara Falls Smelting & Refining Corp., 2204 Elmwood Ave., Buffalo.

ALUNDUM AGGREGATES For Concrete Floors

Norton Co., Worcester, Mass.

ANNEALING OVENS—See Ovens—Annealing

ARC WELDING EQUIP.

General Electric Co., Schenectady, N. Y.

ARCHITECTS—Industrial

Chase, Frank D., Inc., 720 N. Michigan Ave., Chicago.

BAKELITE

Bakelite Corp., 247 Park Ave., New York City

BAND SAWS—See Saws—Metal Band

BABBITT METAL

Ajax Metal Co., 46 Richmond St., Philadelphia.

BANDS—Steel—See Steel Bands

BANDS, SNAP FLASK—Steel

Adams Co., The, 175 Foster St., Dubuque, Iowa.
Diamond Clamp & Flask Co., 38-40 No. 14th St., Richmond, Ind.
Federal Foundry Supply Co., 4600 East 71st St., Cleveland, O.
Shanafelt Manufacturing Co., 1228 4th St., S. W., Canton, O.

BARROWS—Foundry

Sterling Wheelbarrow Co., Milwaukee, Wis.

BARS—Iron and Steel

Bethlehem Steel Co., Bethlehem, Pa.

BELLOWS—Molders

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Whitehead Bros. Co., 537 West 27th St., New York City.

BENCHES—Patternmakers

Diamond Clamp & Flask Co., 38-40 No. 14th St., Richmond, Ind.

BINDERS—See Core Binders

BLACKING MIXTURE

Dixon, Jos., Crucible Co., Jersey City, N. J.
Stevens, Frederic B., Inc., Larned and Third Sts., Detroit, Mich.

BLAST METERS

Clark, Chas. J., Blast Meter Co., Bladbrook, Iowa.

BLOCKS—Chain

Box Crane & Hoist Corp., 2226 Ontario St., Philadelphia.
Yale & Towne Mfg. Co., Stamford, Conn.

BLOW COCKS

Adams Co., The, 175 Foster St., Dubuque, Iowa.

BLOWERS

Aluminum Foundry Equipment Co., The, 319 Plymouth Bldg., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Monarch Engineering & Mfg. Co., 1206 American Bldg., Baltimore.
Northern Blower Co., 6409 Barberton Ave., Cleveland.
Roots, P. H. & F. M., Co., Connersville, Ind.

BLOWERS—Electric—Hand

United States Electrical Tool Co., Cincinnati, O.

BLOWERS—Rotary Positive

Roots, P. H. & F. M., Co., Connersville, Ind.

BLOWPIPES—Brazing, Cutting, Welding, etc.

Oxweld Acetylene Co., Newark, N. J.

BOLTS AND NUTS

Bourne-Fuller Co., 1912 Scranton Rd., Cleveland, O.

BOND—Molding Sand

Eastern Clay Products, Inc., Ellicott Square Bldg., Buffalo.
Federal Foundry Supply Co., 4600 East 71st St., Cleveland, O.

BOOKS—Technical

Penton Publishing Co., Cleveland.

BOTTOM PLATES—Steel

Adams Co., The, 175 Foster St., Dubuque, Iowa.
Diamond Clamp & Flask Co., 38-40 N. 14th St., Richmond, Ind.
Shanafelt Manufacturing Co., 1228 Fourth St., S. W., Canton, O.
Truscon Steel Co., (Hydraulic Pressed Steel Division) Youngstown, O.
Wadsworth Core Machine & Equip. Co., Akron, O.

BOXES—Tote

Sterling Wheelbarrow Co., Milwaukee, Wis.

BRICK—Ladle

Brighton Fire Brick Co., Block House Run, New Brighton, Pa.
McLain Fire Brick Co., 1900 Koppers Bldg., Pittsburgh, Pa.

BRICK—Refractory

Norton Co., Worcester, Mass.

BRICK—Rubbing, Scouring

Carborundum Co., Niagara Falls.
Norton Co., Worcester, Mass.

BRIQUETS—See Charcoal—Briquets

BRONZE—Manganese

Ajax Metal Co., 46 Richmond St., Philadelphia.

BRUSHES

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Paxson-Taggart, Inc., Luzerne and D Sts., Philadelphia, Pa.
Whitehead Bros. Co., 537 W. 27th St., New York City.

BRUSHES—Motor and Generator

Dixon, Jos., Crucible Co., Jersey City, N. J.
General Electric Co., Schenectady, N. Y.
United States Graphite Co., Saginaw, Mich.

BRUSHES—Wire

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, O.
Shanafelt Mfg. Co., 1228 4th St., S. W., Canton, O.

BUCKET CARRIERS—Pivoted

Link Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Milwaukee Electric Crane & Hoist Corp., Milwaukee, Wis.

BUCKET LOADERS for Sand Mills

National Engineering Co., 549 W. Washington Blvd., Chicago, Ill.

BUCKETS—Clam Shell, Drag Line, Grab

Brosius, Edgar E., 19th St. and P. R. R., Sharpsburg P. O., Pittsburgh, Pa.
Harnischfeger Corp., 3800 National Ave., Milwaukee, Wis.
Whiting Corp., Harvey, Ill.
Williams, G. H., Co., 611 Hayburger Lane, Erie, Pa.

BUCKETS—Line

Milwaukee Electric Crane & Hoist Corp., Milwaukee, Wis.